3030/3060 PowerProfiler User's Guide

BMI

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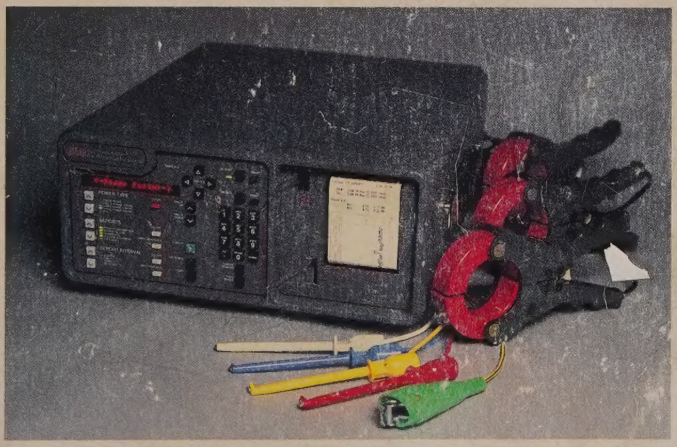

This manual is to be used for PowerProfilers with Firmware Revision 3.0 only.
Press CALIBRATE to get a printout showing which firmware is installed on your PowerProfiler.

This symbol indicates maximum input voltage to instrument not to exceed 600 Vrms.

Protective ground (earth) terminal.

WARNING

The installation instructions in this manual are for use by qualified personnel only. *Do not install this instrument on a power line unless you are qualified to do so.* High voltages that cause burns and lethal shocks are present during power monitoring. When making connections to power lines, always connect the safety earth ground first.

USE STANDARD HIGH-VOLTAGE, HIGH-CURRENT SAFETY PRECAUTIONS.

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3030/3060 PowerProfiler
User's Guide

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About this Manual

This manual is organized to get you started right away:

Chapter 1, Quick Start gets you started with your PowerProfiler. **1**

Chapter 2, About your PowerProfiler describes the features of the PowerProfiler and optional packages you can choose for your specific needs. **5**

Chapter 3, Connecting to Power covers how to hook the PowerProfiler up to any type of power: single-phase, single-phase 3-wire, 3-phase 3-wire, or 3-phase 4-wire. **15**

Chapter 4, Setting Menus describes all the menus available in the PowerProfiler, and how to set up thresholds. **25**

Chapter 5, Using the Meters shows you all of the meter readings the PowerProfiler provides. **29**

Chapter 6, Printing and Paper Loading describes how to print snapshots, reports, and meter readings. **31**

Chapter 7, 3060 Disk Operation covers the procedures for using the disk drive in the 3060 PowerProfiler or an A-600 Parallel Processor with a 3030 PowerProfiler. **35**

Chapter 8, Efficiency Measurements shows you how to use two PowerProfilers to measure efficiency of a system or a subsystem. **37**

Chapter 9, RS-232, Modem Connections shows you how to connect two or more PowerProfilers in a network, so that you can control them from an IBM PC AT or another PowerProfiler. **39**

Chapter 10, Installing Software Option Packages shows you how to install your Software Option Packages if you've purchased them after you bought your PowerProfiler. **43**

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About this Manual

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Chapter 18, Troubleshooting shows you how to diagnose a problem with the PowerProfiler's operation.....**72**

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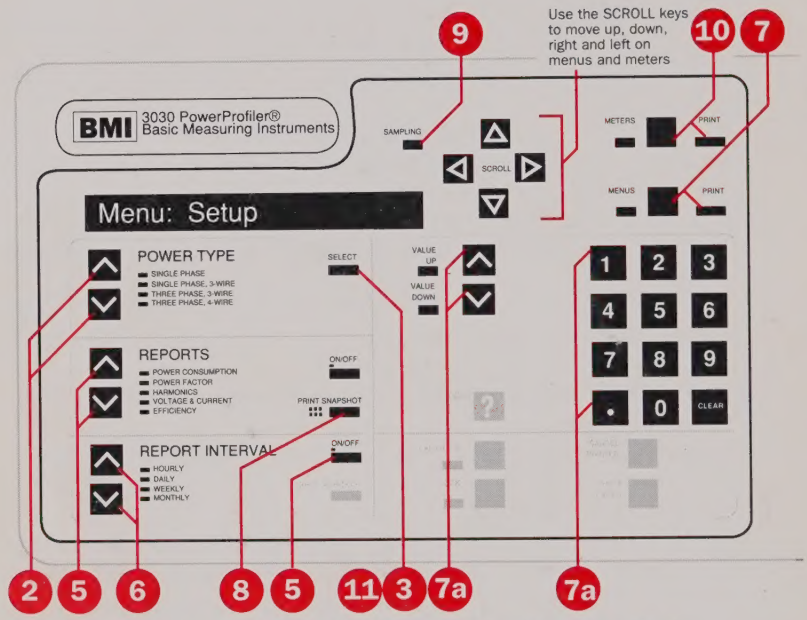
Quick Start 1

This chapter shows you how to get your PowerProfiler up and running right away. More complete instructions can be found in the following chapters. Also use this chapter for reference, when you want to re-set up your PowerProfiler.

WARNING: You are working with high voltages that cause burns and lethal shocks. Connect the safety (or earth) ground first. USE STANDARD SAFETY PRECAUTIONS.

1 Quick Start



■ ***Figure 1-1*** *Front Panel of the PowerProfiler with setup steps*

1. **Plug in your PowerProfiler and turn it on.**
The ON/OFF (I/O) switch is on the rear of your PowerProfiler.

2. **Select the power type.**
Press the UP/DOWN arrows until your selection flashes.

3. **Press the SELECT key to lock in the power type.**

4. **Connect SmartProbes and voltage cables to power lines.**
For more information turn to the Chapter 3, "Connecting to Power."

5. **Choose REPORTS**
Use the UP/DOWN keys in the REPORTS section to get your selection flashing. Then press the ON/OFF key. Repeat for each report you want. Choose VOLTAGE & CURRENT reports to verify your connections (step 8, below).

6 **Choose REPORT INTERVAL.**
Use the UP/DOWN keys in the REPORT INTERVAL section to get your selection(s) flashing. Press the ON/OFF key.

7 **Press the MENUS key and choose the SETUP menu.**
Press the DOWN SCROLL arrow to scroll through the setup menu. Use the VALUE UP/VALUE DOWN keys and keypad to enter date, time, and all other setup questions (7a) (See Chapter 4, "Setting Menus", page 25). Press the PRINT key for a full list of your menu settings.

8 **Press PRINT SNAPSHOT to verify.**
You'll get a snapshot of all the reports you have chosen; at the end you'll get phasor diagrams of voltage and current. Check these to verify that you're connected correctly. (See Chapter 3, page 22 for an explanation of phasor diagrams.)

9 **Check that the SAMPLE light flashes green.**
If it flashes red, you're not connected correctly. If it flashes orange, you may or may not be connected correctly. Press the Meters key, then press HELP. Or, turn to Chapter 3, "Connecting to Power.".

10 **Press the METERS key to get meter readings.**
Press the DOWN SCROLL arrow to scroll through the meter readings. Press the PRINT key if you want a list of meter readings.

11 **Clear accumulated data (optional).**
If you want to clear all data accumulated during setup, press SELECT and hold for two seconds. Answer YES by pressing the DOWN SCROLL arrow. For more information on clearing accumulated data and settings, see Chapter 3, "Connecting to Power," page 15.

■ ***Figure 2-1*** *The PowerProfiler with voltage cables and SmartProbes*

Features

The PowerProfiler measures and describes all aspects of your power consumption and, with options, can monitor power demand, cost, and harmonics. From a single load to an entire building, the PowerProfiler accurately measures power for any type of load. The basic PowerProfiler provides meter readings and graphical summaries of watts, VA, VARs, power factor, and total harmonic distortion (THD).

All PowerProfilers are capable of measuring single- and three-phase systems. A high-resolution thermal printer, RS-232 port, and four environmental channels are standard on every PowerProfiler. A cable pallet, voltage measuring cables, four rolls of thermal paper, and a User's Guide are enclosed with every instrument.

All PowerProfilers provide the following standard power measurements when used with BMI SmartProbes to measure current:

Meter Readings: RMS voltage, RMS current, true power (W), apparent power (VA), true power factor (PF), displacement power factor (dPF), reactive power (VAR), total harmonic distortion (THD: voltage and current), voltage imbalance, current imbalance, and frequency.

Snapshot Reports: Printed reports of instantaneous power consumption, voltage, current, true power (W), apparent power (VA) reactive power (VAR), true power factor (PF), displacement power factor (dPF), crest factor, form factor, and phasor diagrams.

Graphic Reports: *(At pre-selected intervals: hourly, daily, weekly, or monthly)*—RMS voltage, RMS current, true power (W), apparent power (VA), reactive power (VAR), true power factor (PF), displacement power factor (dPF), total harmonic distortion (THD; voltage and current), and frequency.

The 3030 PowerProfiler
The 3030 PowerProfiler comes standard with a built-in automatic paper takeup system and spare takeup spools.

The 3060 PowerProfiler
The 3060 adds an IBM PC AT-compatible disk storage system in place of the paper takeup. You can store up to 400 reports (2 rolls of printer reports) on a 3.5 inch diskette. PowerTalk™ software for IBM PC ATs and compatible computers is also included with every 3060. See page 53 for more information about PowerTalk.

Software Option Packages

Software Option Packages add specialized monitoring capabilities to your PowerProfiler. These can be installed at any time. For installation, see Chapter 10, "Installing Software Option Package Modules."

Demand Option Package P-301
Provides cash flow and billing demand interval calculations and reports. Enter your billing demand interval and sliding window to plot your consumption the same way that the utility meters your power. Cash flow reports show you how your money is spent—in any currency.

Harmonics Option Package P-302
Provides harmonic spectrum and harmonic power direction measurements and reports up to the 50th harmonic. The Package reports the magnitudes of individual harmonics as volts and amps, or as a

percentage of fundamental. If you're interested in a particular harmonic, you can select up to four individual harmonics for display in the meter window and for automatically-printed summary reports. From the harmonic data, the Package will make useful power calculations such as transformer derating and telephone interference factor.

Neutral Option Package P-303
The Neutral Option Package measures the actual neutral-to-ground voltage while you monitor any power type (except three-phase delta) and will calculate the neutral current from the phase currents. When used with the Harmonic Option Package P-302, you can also obtain a harmonic analysis for the neutral current.

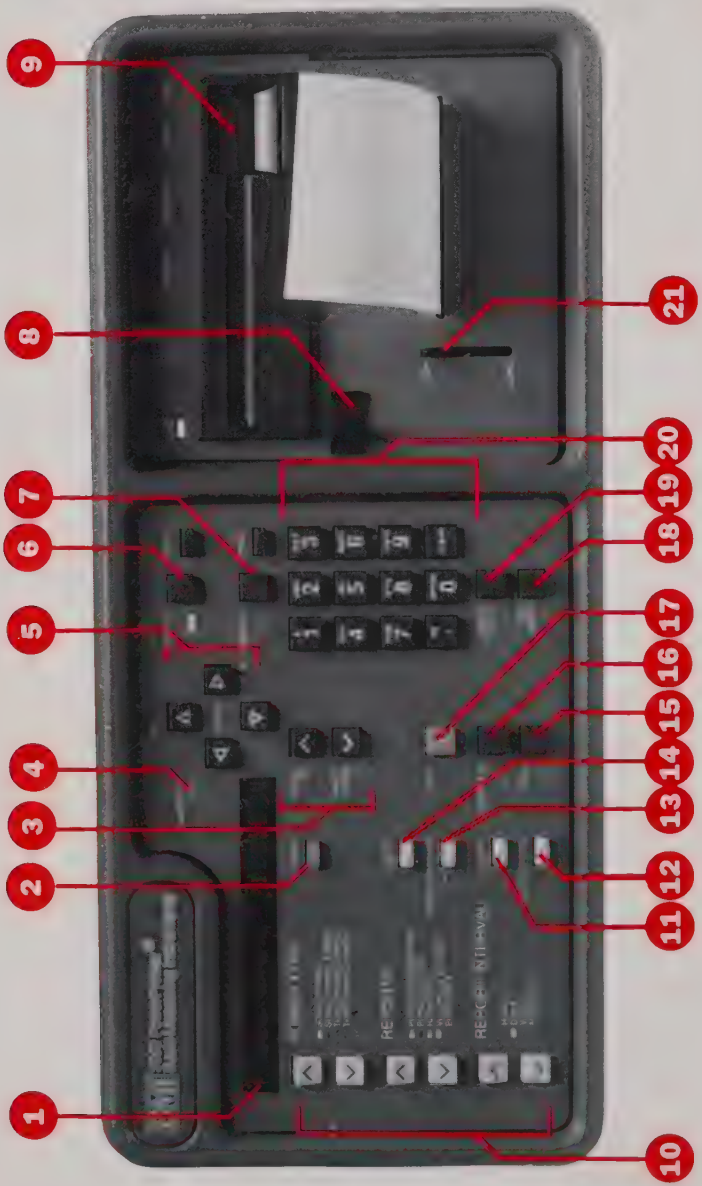
Communications Option Package G-206
Provides an internal modem for communication between PowerProfilers, or to IBM PC ATs and compatibles using BMI's optional PowerTalk™ software. The Communication Option Package places an internal auto-dial, auto-answer modem inside the PowerProfiler and allows the PowerProfiler to communicate over phone lines. You can control remote PowerProfilers with modems in the field from either:

A master PowerProfiler fitted with the Communications Option Package, or...

an IBM PC AT or compatible computer with modem running BMI's PowerTalk software.

■ ***Figure 2-2*** *The 3030 PowerProfiler front panel*

1. **DISPLAY WINDOW** - shows meter readings, menus.
2. **SELECT** - enters selection.
3. **VALUE UP/VALUE DOWN KEYS** - scroll through menu choices.
4. **SAMPLING** - Flashes green when the PowerProfiler is sampling and is connected correctly. Flashes orange if connected out of sequence or in reverse power flow. Flashes red if incorrectly connected.
5. **SCROLL KEYS** - scrolls through menus, meter readings.
6. **METERS** - displays meter readings (for complete meter readings, see pages 98-103).
   PRINT - (next to meters key) prints all meter readings.
7. **MENUS** - displays menus (for complete menus, see pages 86-97).
   PRINT - (next to menus key) prints menu settings.
8. **PRINTER DOOR RELEASE** - opens for paper loading.
9. **PAPER TAKEUP** - automatically takes up printed graphs and reports.
10. **UP/DOWN KEYS** - moves you to selections.
11. **ON/OFF** - enters selection.
12. **PRINT REPORTS** - prints selected reports gathered since last scheduled report.
13. **PRINT SNAPSHOTS** - prints an instantaneous snapshot of all selected reports.
14. **ON/OFF** - enters selection.
15. **LOCK** - locks and disables keyboard (LOCK, then CLEAR unlocks keyboard)
16. **CALIBRATE** - prints Calibration Report and accesses Calibration Menu (Press CALIBRATE key, then UP SCROLL arrow to get to the Calibration Menu).
17. ***HELP!*** - pressing HELP key gives useful advice, alerts you to problems and gives the range of values the PowerProfiler will accept.
18. **FEED PAPER** - advances paper.
19. **CANCEL PRINTER** - cancels current message or report (CANCEL PRINTER quickly followed by UP SCROLL arrow resets instrument, but does not clear any accumulated data).
20. **NUMBER/LETTER KEYPAD** - enters values for menu setup.
21. **RUN/LOAD lever** - engages/releases paper roller.



■ **Figure 2-3** *The 3060 PowerProfiler front panel*

1. **DISPLAY WINDOW** - shows meter readings, menus.
2. **SELECT** - enters selection.
3. **VALUE UP/VALUE DOWN KEYS** - scroll through menu choices.
4. **SAMPLING** - Flashes green when the PowerProfiler is sampling and is connected correctly. Flashes orange if connected out of order or in reverse power flow. Flashes red if incorrectly connected.
5. **SCROLL KEYS** - scrolls through menus, meter readings.
6. **METERS** - displays meter readings (for complete meter readings, see pages 98-103).
   PRINT - (next to meters key) prints all meter readings.
7. **MENUS** - displays menus (for complete menus, see pages 86-97).
   PRINT - (next to menus key) prints menu settings.
8. **PRINTER DOOR RELEASE** - opens for paper loading.
9. **DISK DRIVE**- accepts 720 Kb 3.5" diskettes.
10. **UP/DOWN KEYS** - moves you to selections.
11. **ON/OFF** - enters selection.
12. **PRINT REPORTS** - prints selected reports since last scheduled report.
13. **PRINT SNAPSHOTS** - prints an instantaneous snapshot of all selected reports.
14. **ON/OFF** - enters selection.
15. **LOCK** - locks and disables keyboard (LOCK, then CLEAR unlocks keyboard)
16. **CALIBRATE** - prints Calibration Report and accesses Calibration Menu (Press CALIBRATE key, then UP SCROLL arrow to get to the Calibration Menu).
17. ***HELP!*** - pressing HELP key gives useful advice, alerts you to problems and gives the range of values the PowerProfiler will accept.
18. **FEED PAPER** - advances paper.
19. **CANCEL PRINTER** - cancels current message or report (CANCEL PRINTER quickly followed by UP SCROLL arrow resets instrument, but does not clear any accumulated data).
20. **NUMBER/LETTER KEYPAD** - enters values for menu setup.
21. **RUN/LOAD lever** - engages/releases paper roller.

Figure 2-3 *The 3030/3060 PowerProfiler rear panel*

1. **SMARTPROBE CURRENT INPUTS** - accepts BMI SmartProbes.

2. **ENVIRONMENTAL** - accepts BMI environmental probes.

3. **RS-232** - accepts RS-232 cable; connects to IBM PC AT, another PowerProfiler, or an external modem.

4. **EXPANSION** - accepts BMI accessories (such as A-600 Parallel Processor) and future enhancements.

5. **I/O** - turns instrument power ON/OFF.

6. **POWER INPUT** - accepts AC power cord.

7. **SUPPLY VOLTAGE** - sets the Supply Voltage Setting to either 120 VAC or 240 VAC.

Voltage ranges

Setting	Operating frequency	Voltage range	Power consumption
120 V	50/60 Hz	90-150	100 VA max
240 V	50/60 Hz	180-270	100 VA max

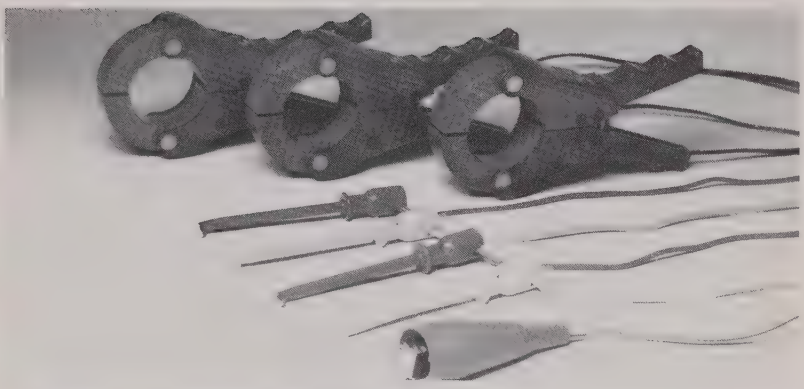
8. **VOLTAGE SAFETY CONNECTORS** - accepts BMI voltage monitoring cables.

9. **NEUTRAL CONNECTOR** - accepts BMI voltage monitoring neutral cable.

10. **GROUND CONNECTOR** - accepts BMI voltage monitoring ground cable.

11. **LINE** - accepts RJ-11 phone line connector when optional internal modem (Communication Option Package G-206) is installed.

12. **PHONE** - connection to phone handset to allow use of single telephone line both for telephone communication and connection to remote IBM PC ATs or other PowerProfilers.



■ ***Figure 3-1*** *SmartProbes and cables*

This chapter shows you how to connect your PowerProfiler. It lists all the cables and probes you'll need, describes how to connect to all types of power, and shows you graphs to help you check your connections.

Checklist of cables and probes you will need

For single phase:
1 SmartProbe, 1 voltage cable, 1 ground cable, 1 neutral cable

For single-phase 3-wire:
1 SmartProbe, 2 voltage cables, 1 ground cable, 1 neutral cable

For 3-phase 3-wire (Δ):
2 or 3 SmartProbes, 3 voltage cables, 1 ground cable

For 3-phase 4-wire (Y):
3 SmartProbes, 3 voltage cables, 1 ground cable, 1 neutral cable

WARNING: You are working with high voltages that cause burns and lethal shocks. Connect the safety (or earth) ground first. USE STANDARD SAFETY PRECAUTIONS.

3 Connecting to Power

Find the number of phases.

1. **Count the number of current-carrying conductors.**
   (Count the neutral conductor if you find one, but don't count the ground or earth conductor).

2. **Follow Table 3-1.**

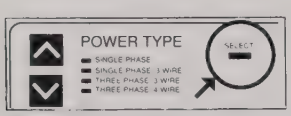
One Conductor	This isn't possible. You must have more than one current-carrying conductor; otherwise, no power can flow. Count again.
Two Conductors	You have single-phase.
Three Conductors	You have either 3-phase 3-wire or single-phase 3-wire. If you're not sure, connect your PowerProfiler for 3-phase 3-wire. Print a Voltage snapshot (see step 2, page 21). Compare your voltage phasor diagram to the ones on pages 22-23 to choose which type of power you have.
Four Conductors	You have 3-phase 4-wire.
Five Conductors	You've counted wrong (don't count the ground wire), or you have more than one power system, or your power has more than three phases. Try again (It is highly unlikely that you would have more than three phases).

■ ***Table 3-1*** *Current-carrying conductors*

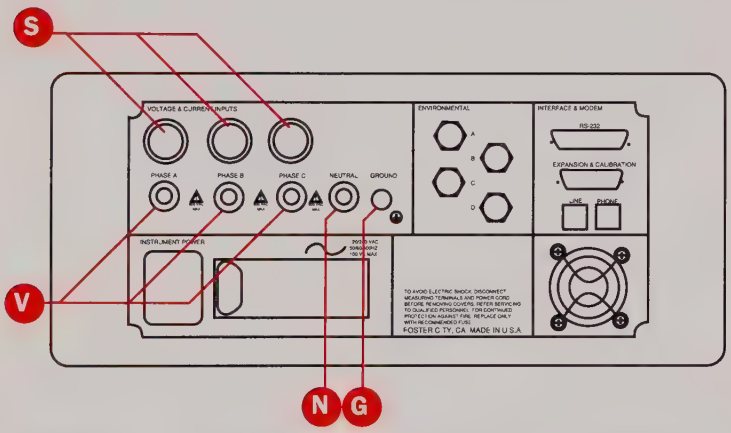
Set the power type.

1. **Press the UP/DOWN keys under the POWER TYPE until you have a flashing red light on the power type you want.**

2. **Press SELECT.**



■ ***Figure 3-2*** *Setting power type*



■ ***Figure 3-3*** *Connecting ground (G), neutral (N), voltage cables (V), and SmartProbes (S)*

Connect the voltage cables.

1. **Connect the GROUND.**
2. **Connect the NEUTRAL (if there is one).**
3. **Connect the VOLTAGE PHASE LEAD(S) (see Table 3-2).**

Single Phase	*Single-Phase 3-wire*	*3-Phase 3-wire*	*3-Phase 4-wire*
Ground Phase A Neutral	Ground Phase A Phase B Neutral	Ground Phase A Phase B Phase C	Ground Phase A Phase B Phase C

■ ***Table 3-2*** *Connecting by phase*

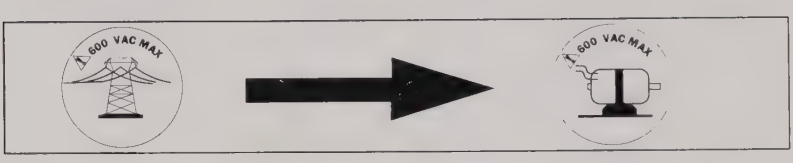
WARNING: You are working with high voltages that cause burns and lethal shocks. Connect the safety (or earth) ground first. USE STANDARD SAFETY PRECAUTIONS.

3 Connecting to Power

Connect the SmartProbes to SmartProbe channel inputs.

1. **Make sure SmartProbes correspond by phase to the voltage cables.** See Figures 3-5 to 3-8, pages 19-20 and Table 3-2. You can also use phasor diagrams to verify connections (see pages 22-23).

2. **Clamp the SmartProbe(s) on conductors matching the direction of power flow.**



■ ***Figure 3-4*** *Matching the direction of power flow with the SmartProbe* (See Figure 3-4).

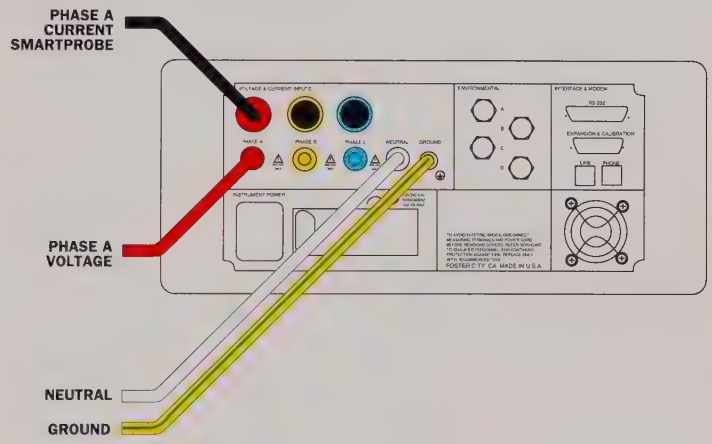
3. **Check your voltage and SmartProbe connections.** See Table 3-3. These color codes are often, but not always, followed. Use them as a guide.

Location	Voltage	Phase A	Phase B	Phase C	Neutral	Earth
USA	120	Black			White	Green or bare
USA	120/208	Black	Red	Blue	White	Green or bare
USA	480	Brown	Orange	Yellow		Green or bare
USA	Distrib.	Black	White	Red		
Int'l	single-ph	Brown			Blue	Green/yellow
Int'l	3-phase	Red	Yellow	Blue		Green/Yellow
PowerProfiler Back Panel						

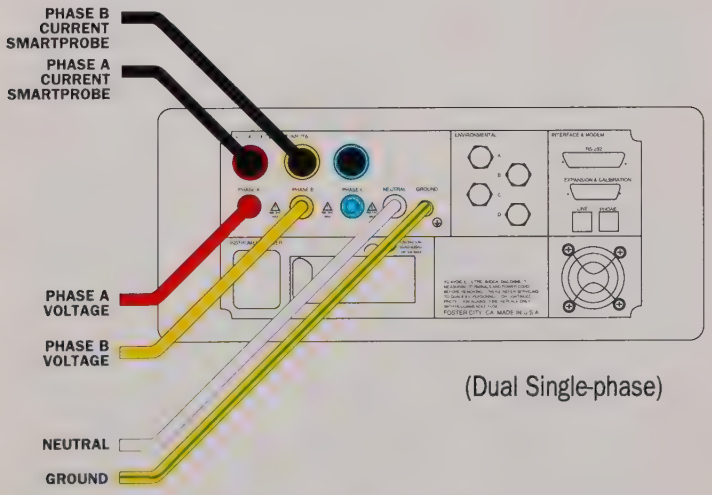
■ ***Table 3-3*** *Connecting voltage cables and SmartProbes to colored conductors*

4. **Use the colored O-rings provided with your SmartProbes to make sure voltage and SmartProbes match by color for each phase.** For example, slip the red O-rings onto the SmartProbe module and connector to correlate with the red voltage cable.

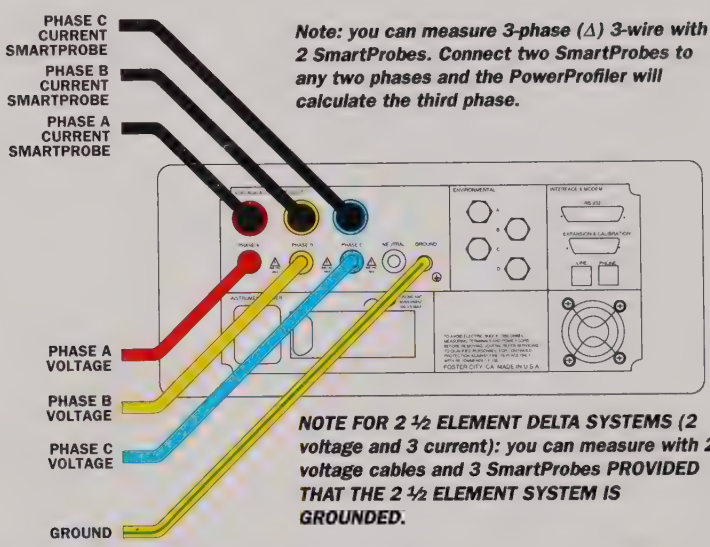
Connecting Diagrams
Check your connections.



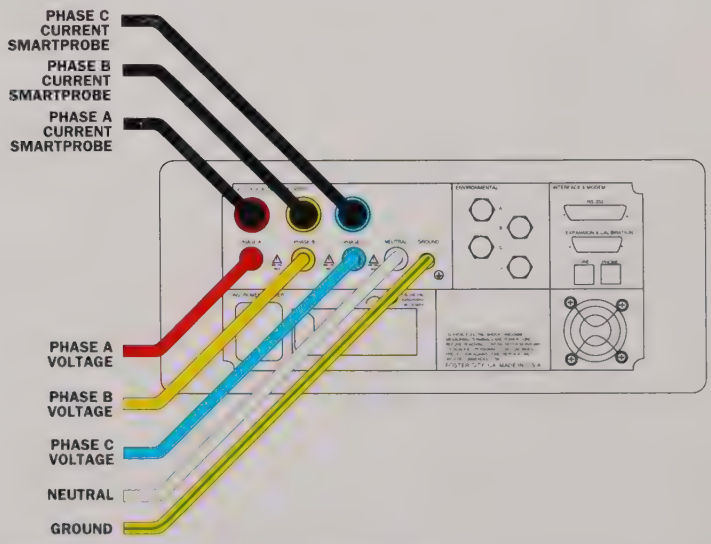
■ ***Figure 3-5*** *Single-phase connections*



■ ***Figure 3-6*** *Single-phase, 3-wire connections*

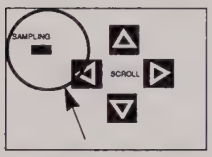

PHASE C CURRENT SMARTPROBE
PHASE B CURRENT SMARTPROBE
PHASE A CURRENT SMARTPROBE
PHASE A VOLTAGE
PHASE B VOLTAGE
PHASE C VOLTAGE
GROUND
Note: you can measure 3-phase (Δ) 3-wire with 2 SmartProbes. Connect two SmartProbes to any two phases and the PowerProfiler will calculate the third phase.
NOTE FOR 2 ½ ELEMENT DELTA SYSTEMS (2 voltage and 3 current): you can measure with 2 voltage cables and 3 SmartProbes PROVIDED THAT THE 2 ½ ELEMENT SYSTEM IS GROUNDED.

■ ***Figure 3-7*** *3-phase, 3-wire (Δ) connections*



■ ***Figure 3-8*** *3-phase, 4-wire (Y) connections*

1. **Check the sampling light.**



■ ***Figure 3-9*** *Sampling light*

	Flashing green	You have correct connections for the power type selected.
	Flashing orange	Signals are available, but: (1) one or more of the three phase connections is connected out of sequence (go to Step 2), or (2) SmartProbe connection does not follow power flow (Go to Step 2 or see Figure 3-4).
	Flashing red	No signals available; you have not made your connections.

■ ***Table 3-4*** *Flashing sampling light*

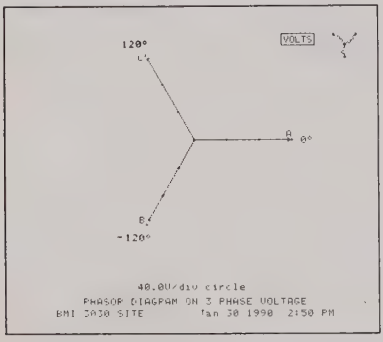
2. **Print out a phasor diagram (best choice for three-phase).** Select VOLTAGE & CURRENT under REPORTS. When the light is flashing, press PRINT SNAPSHOT. You will get a printout of phasor diagrams. The diagrams will help you see if you're incorrectly connected. Refer to sample diagrams on pages 22-23.

3. **Use *HELP?* messages (best choice for single-phase).** Press the Meters key. Then press the *HELP?* key.

3 Connecting to Power

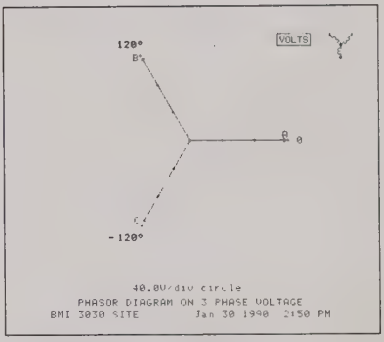
Using phasor diagram snapshots to verify connections

Voltage phasor diagram snapshot



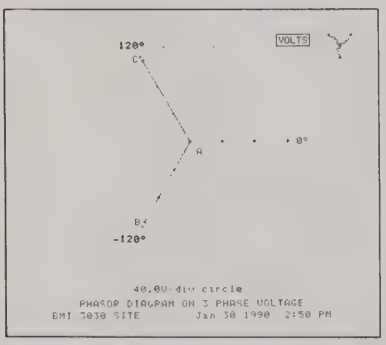
■ ***Figure 3-10*** *Correct connection for 3-phase system*

Voltage phasor diagram snapshot



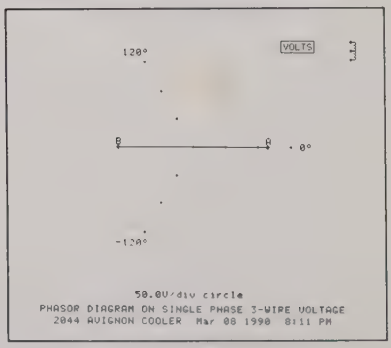
■ ***Figure 3-11*** *Phases B and C out of order*

Voltage phasor diagram snapshot



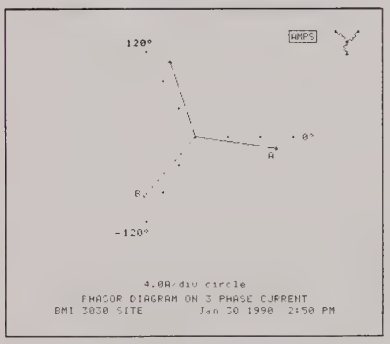
■ ***Figure 3-12*** *Phase A voltage cable not connected or zero volts*

Voltage phasor diagram snapshot



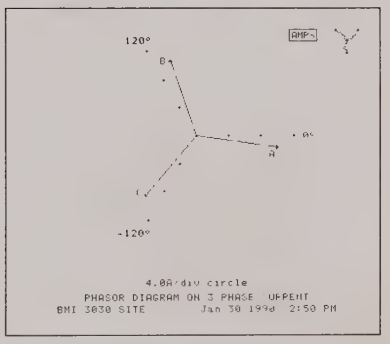
■ ***Figure 3-13*** *Correct connection for dual-single phase*

Current phasor diagram snapshot



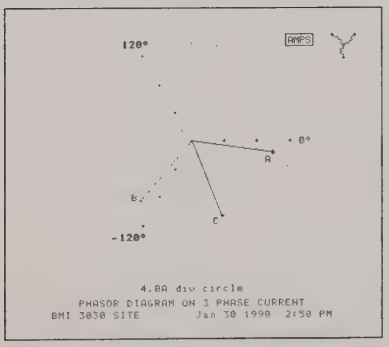
■ ***Figure 3-14*** *Correct current connections*

Current phasor diagram snapshot



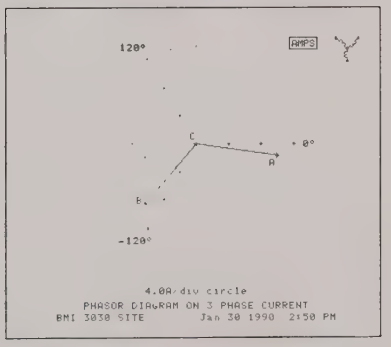
■ ***Figure 3-15*** *Phases B and C out of order*

Current phasor diagram snapshot



■ ***Figure 3-16*** *Correct phase connections, but Phase C SmartProbe connected to wrong direction of power flow*

Current phasor diagram snapshot



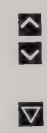
■ ***Figure 3-17*** *Phase A and B connected correctly, but Phase C is either at zero amps or not connected*

3 Connecting to Power

Clearing accumulated data and settings

To clear accumulated data
Your PowerProfiler monitors even while you are connecting to power. Before you start a new monitoring session, clear all data that accumulated during setup.

1. **Press SELECT and hold for 2 seconds.**
2. **Using the VALUE UP/VALUE DOWN keys, choose YES on the menu display:**
   Clear reports <YES> <NO>
3. **Press the DOWN arrow.**



If you want to clear <u>all</u> data and <u>all</u> settings...

To return to PowerProfiler default settings in all menus and clear all accumulated data:

1. **Press CANCEL PRINTER key.**
2. **Press UP SCROLL arrow.**
3. **Press CLEAR key (in KEYPAD).**
   The PowerProfiler will return to single-phase setup.

To restart your PowerProfiler...

You may restart your PowerProfiler either by turning it off, then on, or:

1. **Press CANCEL PRINTER key.**
2. **Press UP arrow.**
   Restarting your PowerProfiler will not clear any settings or data.

NOTE: Changing the power type on the front panel or changing the time or date in the Setup Menu <u>clears all accumulated data.</u>

The following menus are available in your PowerProfiler. You control the programming of measurements and reports with user-entered thresholds and units of measurement. A complete chart of all menus is in the Appendix of this manual, pages 86-97.

Setup Menu
Allows you to enter site name, date, and time, the language for help messages, and the time length for battery backup. Also allows you to choose between assumed and measured voltage and power factor and program voltage and current multipliers.

Rate Structure Menu
Allows you to enter the cost structure of your electrical bill, choose either flat rate or time of day rate structure, enter a sliding window and billing demand interval and whether billing for kWh (kilowatt hours) or kVAh (kilovolt-amp hours).
Only in PowerProfilers with Demand Option Package P-301.

Harmonics Menu
You can choose to monitor up to four different harmonics individually. Also allows you to choose harmonic spectrum for any phase.
Only in PowerProfilers with Harmonics Option Package P-302.

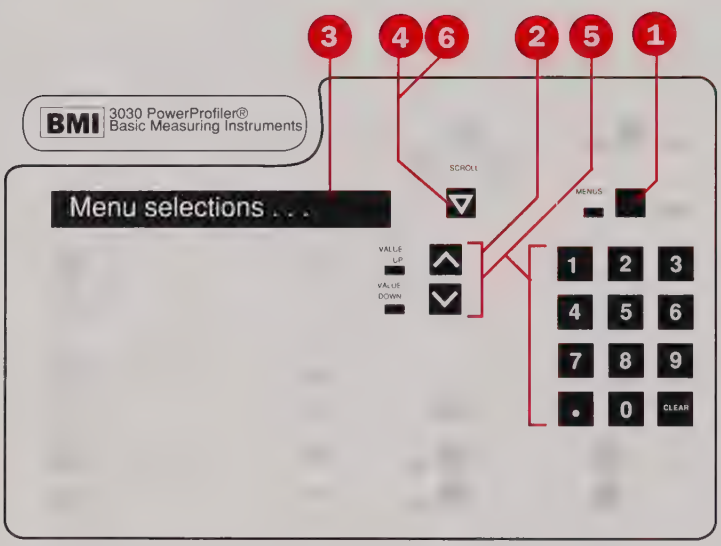
Set Thresholds Menu
You may program individual high and low trigger levels or thresholds for any of the PowerProfiler's measurements. When any threshold is exceeded, your PowerProfiler prints a graph or text message.

Communication Menu
Allows you to control your RS-232 port.

Storage Menu
If you have a 3060, you can initialize disks, store and retrieve data, and replay reports. Also works with an A-600 Parallel Processor disk drive (disk storage options only).

Environmental Menu
Allows you to enter threshold levels for any environmental probes you have connected to your PowerProfiler: Temperature, Temperature/humidity, AC/DC/Impulse or RFI Probe.

4 Setting Menus



■ ***Figure 4-1*** *PowerProfiler front panel menu keys*

How to set the menus

1. **Press the MENUS key twice to get to the top of the Menus.**

2. **Press the VALUE UP/VALUE DOWN keys to scroll up or down through the menu selections. Your menu choices are:**
   - **Setup**
   - **Rate Structure**
   - **Harmonic**
   - **Set Thresholds**
   - **Communication**
   - **Storage**
   - **Environmental**

3. **When you've positioned the menu you want in the display...**

4. **Press the DOWN SCROLL arrow to enter that menu.**

5 **Answer the questions in the menu.**
To do this, use either the keypad or the VALUE UP/VALUE DOWN keys. Use the left and right SCROLL keys to move right and left when entering a word.

6 **Press the DOWN SCROLL arrow.**
This scrolls the display to the next question. The DOWN arrow also enters data you've just entered into the PowerProfiler.

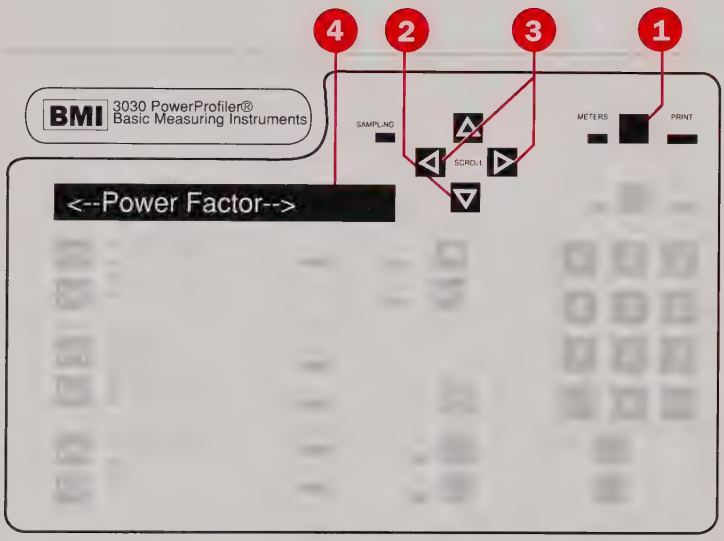
Keep answering questions until the end of menu message appears. If you want to go back, press the UP arrow.

If you want to go back to another menu, press the menus key again.

If you want to go to meters, press the Meters key.

If you want a printout of all your menu settings, press PRINT by the MENUS key.

(7) **Optional step: To begin a new monitoring session, clear accumulated data. Press SELECT and hold for 2 seconds. Use VALUE UP/VALUE DOWN to answer YES, then press the DOWN SCROLL arrow.**
Clearing the PowerProfiler erases all data which was accumulated during setup of menus. See Chapter 3, page 24, "Connecting to Power," for clearing accumulated data.



■ ***Figure 5-1*** *PowerProfiler front panel meter keys*

How to display meter readings

1. **Press the METERS key twice.**
   You will then start with the first meter reading, RMS VOLTAGE.

2. **Press the DOWN SCROLL arrow to scroll through the meters.**

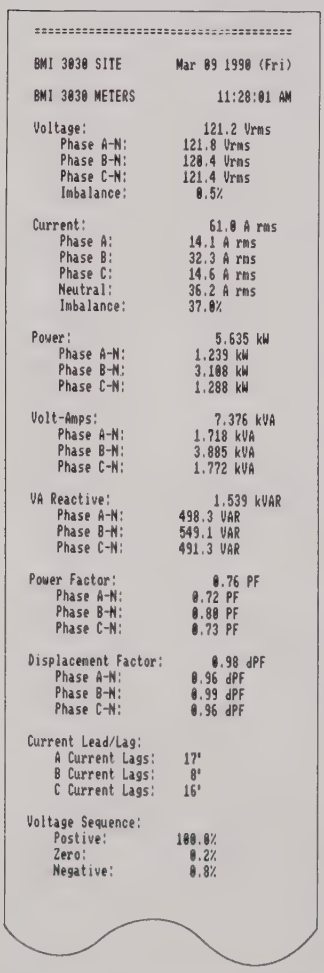
3. **Press the right and left arrow keys to read the other phases, average, or total.**

4. **If you see a message in symbols < >...**
   This is a "placeholder" for conductors you're not using.

5 Using the Meters

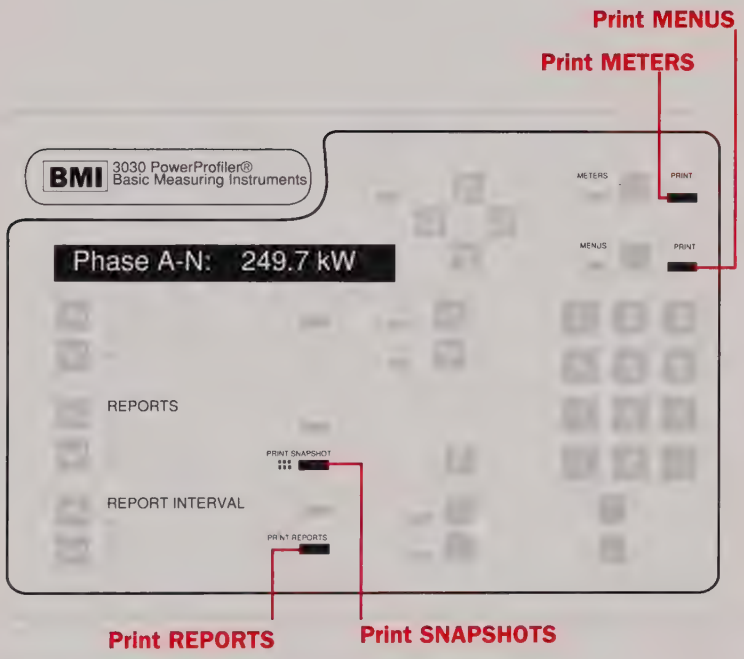
Meter readings

Press PRINT METERS to get a complete printout of all meter readings. For a full map of all meter readings, refer to the Appendix, pages 98-103.



```
========================================

BMI 3030 SITE          Mar 09 1990 (Fri)

BMI 3030 METERS              11:28:01 AM

Voltage:                      121.2 Vrms
    Phase A-N:              121.0 Vrms
    Phase B-N:              120.4 Vrms
    Phase C-N:              121.4 Vrms
    Imbalance:                0.5%

Current:                       61.0 A rms
    Phase A:                 14.1 A rms
    Phase B:                 32.3 A rms
    Phase C:                 14.6 A rms
    Neutral:                 36.2 A rms
    Imbalance:               37.0%

Power:                         5.535 kW
    Phase A-N:               1.239 kW
    Phase B-N:               3.108 kW
    Phase C-N:               1.288 kW

Volt-Amps:                     7.376 kVA
    Phase A-N:               1.718 kVA
    Phase B-N:               3.885 kVA
    Phase C-N:               1.772 kVA

VA Reactive:                   1.539 kVAR
    Phase A-N:             498.3 VAR
    Phase B-N:             549.1 VAR
    Phase C-N:             491.3 VAR

Power Factor:                  0.76 PF
    Phase A-N:               0.72 PF
    Phase B-N:               0.88 PF
    Phase C-N:               0.73 PF

Displacement Factor:           0.98 dPF
    Phase A-N:               0.96 dPF
    Phase B-N:               0.99 dPF
    Phase C-N:               0.96 dPF

Current Lead/Lag:
    A Current Lags:    17°
    B Current Lags:     8°
    C Current Lags:    16°

Voltage Sequence:
    Postive:               100.0%
    Zero:                    0.2%
    Negative:                0.8%

Current Sequence:
    Postive:                90.9%
    Zero:                   29.7%
    Negative:               29.3%

Voltage THD:                    1.9% THD
    A-N Volts:                1.6% THD
    B-N Volts:                1.9% THD
    C-N Volts:                2.3% THD

Current THD:                   83.3% THD
    A Current:                88.7% THD
    B Current:                73.6% THD
    C Current:                87.5% THD

Derate transformer to:     73.3%
   (Eddy current loss set to: 10.0%)

Current TIF:                    2.7k
    A Current TIF:            2.1k
    B Current TIF:            3.3k
    C Current TIF:            2.7k

Average 5th Harmonic Volt:   1.5%
    A-N 5th Volt:             1.4%
    B-N 5th Volt:             1.5%
    C-N 5th Volt:             1.6%

Average 5th Harmonic Amps:  40.8%
    A-N 5th Amps:            48.1%
    B-N 5th Amps:            28.6%
    C-N 5th Amps:            45.8%

Capacity (100 A):              61.0% Cap

Efficiency:                      N/A

Cost/Hour:                   $ 0.338 /Hr

Frequency:                     60.0 Hz

========================================
```

■ ***Figure 5-2*** *Meter readings from a PowerProfiler*



■ ***Figure 6-1*** *Front panel showing keys for printing*

The PowerProfiler will print out reports automatically when you have selected the types of reports and the desired interval(s) you want. Additionally, you can print reports or snapshots on demand. Printing snapshots or reports will not change the automatic printing you have set up.

Printing snapshots

1. **Press the PRINT SNAPSHOT key in the Reports section at any time.**

2. **Your PowerProfiler prints a snapshot for each report you choose.** Your PowerProfiler prints instantaneous snapshots only for reports that are turned on. However, if one of the report lights is flashing green or red, it will print a snapshot of only that report. (See next page for selecting reports.)

6 Printing and Paper Loading

Printing auto snapshots

If you have selected auto snapshots, a snapshot will print every time a threshold is passed. Use the Set Thresholds Menu (page 81) to set up your auto snapshots. You can choose any or all of the thresholds. Be sure to set your thresholds so that the PowerProfiler does not print too many snapshots.

Note: hysteresis is fixed at 5%.

1. **Scroll down the Set Thresholds Menu until you see the choice AUTO SNAPSHOTS.**

2. **Use the VALUE UP/VALUE DOWN keys to choose ON.**
   Press the DOWN SCROLL arrow to enter.

3. **The PowerProfiler will print a report every time a threshold is exceeded and when the value comes back within the threshold.**

Selecting reports

1. **Use the UP/DOWN keys in the Reports section.**

2. **Get your selection to flash green.**
   (flashing red means you will turn this report off)

3. **Press the ON/OFF key.**
   Repeat steps 1 and 2 for each type of report you want.

1. **Press the PRINT REPORTS key in the Reports section.**
   Your PowerProfiler prints the reports you have selected. These reports are of data accumulated since the last report was automatically printed. Data will stay in the PowerProfiler until the next interval report is automatically printed (see Setting the report interval).

Setting the report interval

1. For example, if you want the reports to print every 24 hours, **press either the UP or DOWN key in the Report Interval section.** When the light beside DAILY is flashing,

2. **Press the ON/OFF key.**
   Repeat for every report interval you would like.
   You can turn reports on or off at any time. Your PowerProfiler will

print out reports at any new interval you may select using already stored data. For example, if you decide on Friday that you want weekly reports, the PowerProfiler will go back to the Sunday through Friday it just monitored and print those reports for you on the following Sunday (when that week is completed).

Reports print at the end of the interval (e.g., at the end of 24 hours, at midnight; the end of Sunday for weekly; and the end of the month for monthly unless you have selected a different start date in the Rate Structure Menu).

Printing Meter readings

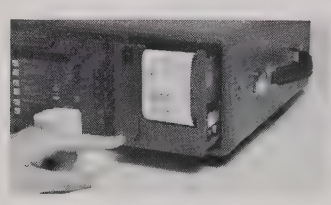
1. **Press PRINT near the Meters key.**
   All meter readings for that instant will print.

Printing Menu setups

1. **Press PRINT near the Menus key.**
   A complete report showing all menu settings will print.

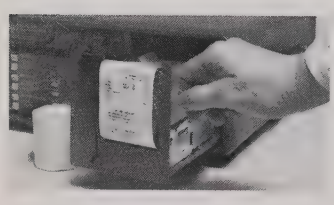
6 Printing and Paper Loading

Loading paper

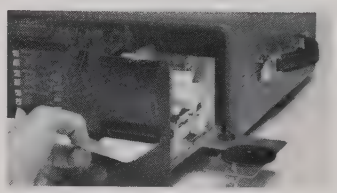


1. Move the RUN/LOAD lever to the LOAD position.
2. Push down on the door release, then pull open the printer.

7. Transfer the empty spool from the load spindle to the takeup spindle.
8. Put a new roll of paper on the load spindle.

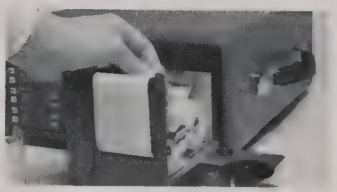


3. Slide the printer all the way out.
4. Turn the handled screw counter-clockwise and open the printer's right side cover.



9. Thread the paper through the printer . . .
10. . . . through the slot in the printer door and tape the paper to the empty spool.

5. Drop open the side cover.
6. Take the full roll of paper off the takeup spindle.



11. Tighten the handled screw. Make sure you hear it snap in place.
12. Close the door and push the lever back to RUN.

For 3060 users: Pull out the printer, remove the old spool by releasing the left knob, then insert a new roll of paper and slide the paper through the front of the door.

Your 3060 PowerProfiler has a built-in disk drive that allows you to store reports and play them back on the printer from the front panel. You can also transfer the disk to a IBM PC AT and review on the PC screen using PowerTalk Version 3.0.

The A-600 Parallel Processor storage options are the same when connected to a 3030 PowerProfiler. The harmonics analysis on the A-600 is unavailable when connected to the PowerProfiler. The main advantage of using the A-600 is having two disk drives. The A-600 must be fitted with A-600 Version 2.0 firmware. Contact BMI Customer Service.

1. **Press MENUS and use the UP/DOWN keys to get to the STORAGE MENU.**
   (The complete Storage Menu is listed in the Appendix, page 95).

2. **Use the DOWN key to select the MODE menu.**

3. **Choose one of the options below.**
   Idle - turns the disk drive off. The 3060 can still monitor, however there will be no storage to the disk drive.

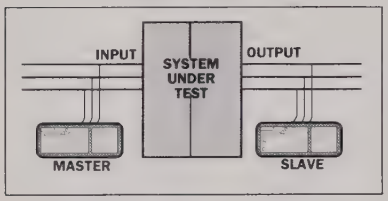
   Record - saves reports to disk. Whenever a report is printed, the information will be stored on disk. The disk holds 720 kb of memory, approximately 400 reports. The printer may be turned on or off when the PowerProfiler is recording data.

   Playback - retrieves reports from the disk and prints them on the PowerProfiler printer. You may print a list of the files on the disk, print all files, or selected files. Using PowerTalk software, you can review these reports on an IBM PC AT. See the PowerTalk manual.

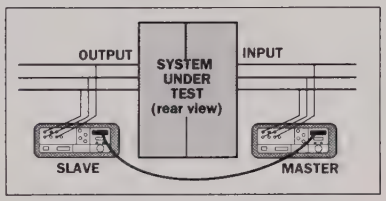
   Initialize - prepares a new disk to store data or erases an old disk. Insert a blank 3.5" double-sided, double-density disk in the disk drive before you choose this option.

Efficiency measurements require two PowerProfilers, each with the Demand Option Package installed.

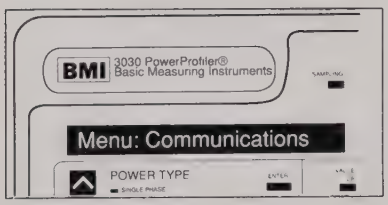
To measure the efficiency of an electrical system or device, connect one PowerProfiler to the input and the other to the output, then connect the PowerProfilers together with RS-232 interface or modems.



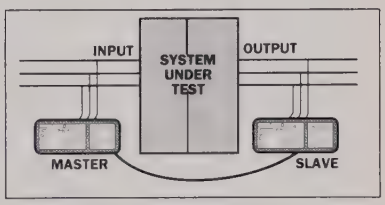
■ ***Figure 8-1*** *Connecting to the system*



■ ***Figure 8-2*** *Connecting the PowerProfilers with RS-232*



■ ***Figure 8-3*** *Setting up the Communications Menu*



■ ***Figure 8-4*** *Designating a master for reports*

To set up for efficiency

1. **Connect one PowerProfiler with ground, voltage cables, and SmartProbes to the input of the system you are monitoring.**

2. **Connect the other PowerProfiler with ground, voltage cables, and SmartProbes to the output of the system.**

3. **Connect the two PowerProfilers together using either the optional modem (G-206) or RS-232 interface.**

4. **Select the Communication menu on each PowerProfiler and answer the questions to control communications. Designate the PowerProfiler at**

the input of the system the MASTER. Designate the PowerProfiler at the output the slave. See Communications Menu, page 93.

5. **The PowerProfiler you designate as the MASTER will print EFFICIENCY reports and display % efficiency in the meter window.**

To print a snapshot of an EFFICIENCY report

1. **Select EFFICIENCY under REPORTS.**

2. **When the light is flashing, press PRINT SNAPSHOT.**

To print graphic summary reports

1. **Be sure EFFICIENCY is selected under reports.**

2. **Select the Report Interval (hourly, weekly, monthly).**
   Your reports will print out automatically for every interval you select.

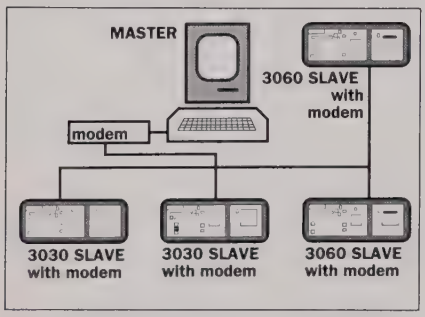
3. **To get a graphic report on demand, press the PRINT REPORTS key.**
   The PowerProfiler will print out graphs of efficiency measured up to that time.

Networking

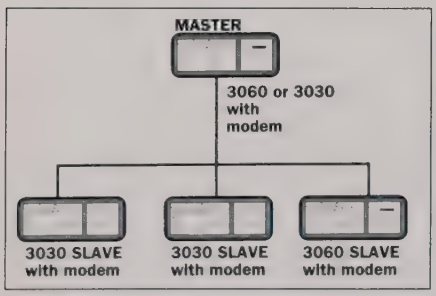
You can create a network of PowerProfilers using modems or RS-232. Each network has one master (a PowerProfiler or IBM PC AT) and one or more slave PowerProfilers. Every PowerProfiler in the network must have a Hayes-compatible modem if you use the telephone network.

Slave PowerProfilers send their reports to the master PowerProfiler.

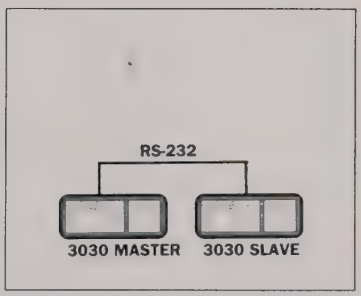
A master 3030 PowerProfiler prints the reports and controls all aspects of the slave PowerProfilers. A master 3060 PowerProfiler or IBM PC AT displays and stores the reports and controls all aspects of the slave PowerProfilers.



■ ***Figure 9-1*** *Connecting an IBM PC AT to PowerProfilers using modems*



■ ***Figure 9-2*** *Master/slave configuration without a PC*



■ ***Figure 9-3*** *Master/slave with RS-232*

9 Communications using RS-232 or Modem

Typically you'll keep the master on your desk, and you'll have several slave PowerProfilers at monitoring sites in the field.

A complete Communication Menu is shown in the Appendix, page 83.

To set up your PowerProfiler for networking:

1. **Connect your PowerProfilers (and your IBM PC AT with PowerTalk 3.0 installed) to each other using either RS-232 or modems.**

2. **Press the MENUS key, then select the Communication Menu using the VALUE UP/VALUE DOWN keys.**

3. **Scroll through the Communication Menu and use the VALUE UP/VALUE DOWN keys to select RS-232, or external or internal modem.**
   If you choose RS-232, you will be asked to choose whether this unit is a master or a slave, and the baud rate.

   If you choose modem, you'll also be asked to put in the telephone numbers in your directory, the type of dialing you'll be using, the answer tone, and a carrier delay time.

4. **Decide whether this PowerProfiler will be a master or a slave.**
   If a slave unit, you will be asked to choose which PowerProfiler you want the slave unit connected to. You can also choose to turn the slave unit's printer off (as the data will be also printed through the master unit if you want it).

   If you choose master, you'll be asked which slave units in your directory you want to connect to.

Receive data all the time, or only when you want
Slave PowerProfilers will automatically dial the master PowerProfiler or IBM PC AT's phone number whenever a report is triggered by passing a threshold or when pre-selected reports are ready to be printed out.

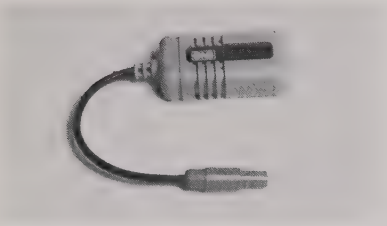
When you want to retrieve reports at your convenience, use the disk storage in the 3060 or the A-600 Parallel Processor connected to a 3030. You can direct the slave PowerProfilers to log reports on their disks instead of calling the master. When convenient, the user initiates a

call via the master to a slave and retrieves the data from each disk. Using disk drives is a good way to ensure against possible loss of data and save phone charges.

Also, to avoid problems with multiple slaves attempting to call one master or high phone charges (slaves dialing the master every few minutes and sending reports), BMI recommends that you set up 3060 PowerProfilers or 3030s with A-600 Parallel Processors as slaves.

Initializing a disk on a slave 3060 PowerProfiler
When you are sure you have received the graphs from your slave 3060 PowerProfiler or A-600 Parallel Processor and you have them stored, you can send a command back to initialize the slave PowerProfiler's disk.

Installing Software Option Package Modules 10



■ ***Figure 10-1*** *Software Option Package Module*

Software option package modules may be purchased after you buy your PowerProfiler and added to your PowerProfiler at any time (order the following part numbers from BMI):

- Demand Option Package Module PM-301
- Harmonic Option Package Module PM-302
- Neutral Option Package Module PM-303

Option Package Modules for the PowerProfiler are fully described in Chapter 11, "Software Option Packages."

To install

1. **Plug the connector on the Software Option Package Module into any SmartProbe current input on the back of the PowerProfiler.**

2. **A menu will prompt you and ask if you want to install the Option. Using the VALUE UP/VALUE DOWN keys, select YES.**

3. **Press the DOWN SCROLL KEY to install the software.**
   The PowerProfiler will install the software, and print out a report verifying that the software was installed. The Software Option Package Module is now empty.

4. **Remove Software Option Package Module probe when prompted.**
   The PowerProfiler will reset.

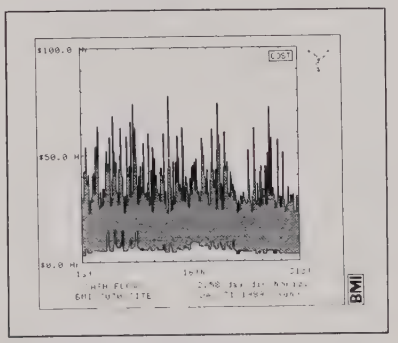
The PowerProfiler recognizes any installed Software Option Package in its menus. Graphs and reports are automatically added to the full list of standard reports.

Demand Option Package PM-301

The Demand Option Package allows you to enter your billing demand interval and sliding window to plot your consumption the same way that the utility meters your power. Enter the unit cost of your electricity and select either flat rate or time-of-day rate structure and a peak demand charge. The PowerProfiler will show you the cost per hour and keep a running total.

Features:

- *Cash flow in any currency*
  Reports show you how your money is spent–in any currency.
- *Load duration*
  The load duration curve will help you decide whether load shifting is feasible.
- *Electrical efficiency*
  See Chapter 8, "Efficiency Measurements." Connect two PowerProfilers together by modems or RS-232 to calculate electrical efficiency automatically.
- *Monitor capacity*
  Enter the maximum safe capacity of your distribution system in watts, VA, or amps and the PowerProfiler will calculate how close you are to maximum capacity.
- *Quantity (Qh)*
  Measurement unit used by some utilities.
- *Meter readings:* efficiency, capacity, cost
- *Graphic reports:* billing demand, cost, efficiency, load duration curve, quantity



■ ***Figure 11-1*** *Graph of cash flow*

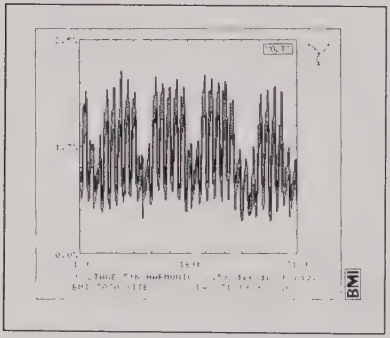
Harmonic Option Package PM-302

The Harmonic Option Package turns your PowerProfiler into a full harmonic analyzer, measuring up to the 50th harmonic for voltage and current on all phases simultaneously. The Package reports the magnitudes of individual harmonics as volts, amps, or as a percentage of fundamental. If you're interested in a particular harmonic, you can select up to four individual harmonics for display in the meter window. You can also report when any of the individual harmonics exceed a pre-selected threshold.

11 Software Option Packages

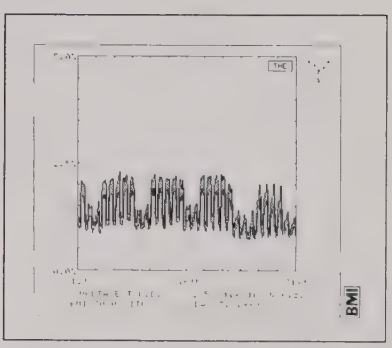
Features:

- *Meter readings:* voltage sequencing, current sequencing, individual harmonics, telephone interference factor, and transformer derating
- *Snapshot reports:* harmonic spectrum, harmonic power direction, individual harmonics
- *Graphic reports:* individual harmonics



■ ***Figure 11-2*** *Harmonics reading showing voltage 5th harmonic*

Neutral Option Package PM-303
The Neutral Option Package measures the actual neutral-to-ground voltage while you monitor any power type (except 3-phase 3-wire) and will calculate the neutral current from the phase currents. When used with the Harmonic Option Package PM-302, you can obtain a harmonic analysis for the neutral current.



■ ***Figure 11-3*** *Current total harmonic distortion*

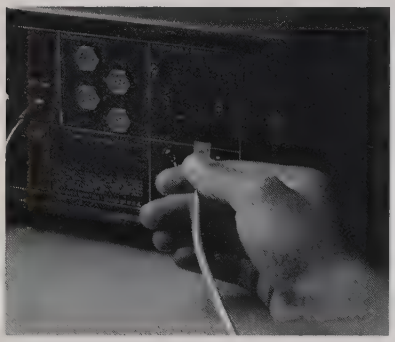
Features:

- *Meter readings:* neutral-to-ground RMS voltage and current
- *Snapshots:* neutral-to-ground voltage waveform, neutral current waveform. Also provides neutral current harmonic spectrum snapshot when used with Harmonic Option Package.
- *Graphic reports:* neutral-to-ground RMS voltage, neutral RMS current. Also provides neutral current THD when used with Harmonic Option Package.

Communications Option Package G-206
(Installed at the factory only)
The Communications Option Package places an internal auto-dial, auto-answer modem inside the PowerProfiler and allows the PowerProfiler to communicate over phone lines. You can control remote PowerProfilers with

modems in the field from either:

- a master Power Profiler fitted with the Communications Option Package (see Chapter 9, "RS-232, modem connections"), or
- an IBM PC AT or compatible computer with modem running BMI's PowerTalk software (see Chapter 7, "3060 Disk Operations" and your PowerTalk manual).



■ ***Figure 11-4*** *Communications adds an internal modem.*

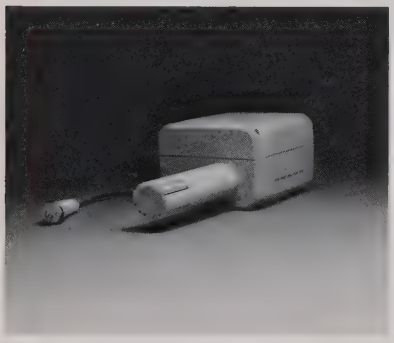
Software option packages may be purchased after you buy your PowerProfiler (order the following part numbers from BMI):

- Demand Option Package PM-301
- Harmonic Option Package PM-302
- Neutral Option Package PM-303

Part numbers for Software Optional Packages purchased with unit and installed at factory:

- Demand Option Package P-301
- Harmonic Option Package P302
- Neutral Option Package P303
- Communications Option Package G-206

The PowerProfiler recognizes any probe installed. Graphs and reports are automatically added to the full list of standard reports.



■ ***Figure 12-1*** *Connecting an environmental probe*

Environmental Probes

To set up Probes

1. **Plug your Probe into one of the environmental channels in the back of the PowerProfiler.** The PowerProfiler's menus and printouts show any probes which you have attached. You can attach up to four probes at any time.

2. **Press the MENUS key, and then the VALUE UP/VALUE DOWN arrows to access the ENVIRONMENTAL MENU. Answer the questions.** The complete Environmental Menu is shown in the Appendix, page 96.

■ ***Figure 12-2*** *Environmental probe for temperature and humidity*

The A-002 Temperature Probe
Measures temperature and rate-of-change in temperature.

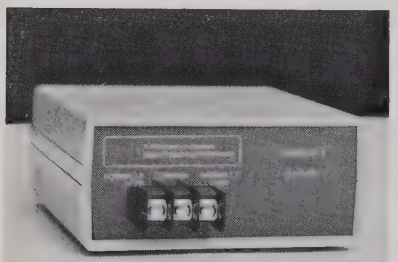
The A-003 Temperature/Humidity Probe
Measures temperature, humidity, and their rates-of-change.

■ ***Figure 12-3*** *AC/DC/Impulse Probe*

12 Optional Probes

The A-111 AC/DC/Impulse Probe
Records power sags, surges, and impulses.

The A-009 Contact Closure Probe
Provides a 2-second contact closure if any of the thresholds are exceeded (See Set Thresholds menu in the Appendix, page 91).



■ ***Figure 12-4*** *Contact Closure Probe*

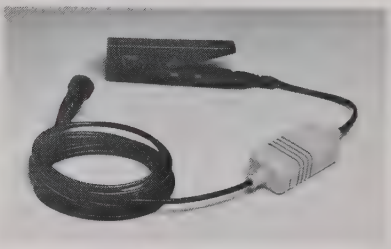
The A-012 RFI Probe Interface
Graphs radio frequency interference using an Instruments for Industry model EFS-3 probe (not included).

The A-014 RFI Probe Interface
Graphs radio frequency interference using a Holaday Industries HI-3004 probe (not included).

SmartProbes

A-115 60 Amp AC Clamp-on SmartProbe
Use this clamp-on probe to take quick measurements of CTs and for monitoring individual loads up to 60 amps.

Range: 1 - 60 A
Usable Bandwith: 45 Hz - 65 Hz
Isolation: 3000 V
Max. cable diameter: .47 in (12mm)



■ ***Figure 12-5*** *A-115 SmartProbe*

A-116 600 Amp AC clamp-on SmartProbe
This is the general purpose current probe for most applications.

Working voltage: 600 V
Isolation: 2000 V
Range: 1 - 600 A
Usable Bandwith: 50 Hz - 3 kHz
Max. cable diameter: 2 in (54 mm)

■ ***Figure 12-6*** *A-116 SmartProbe*

A-119 10 Amp Current Transformer Interface SmartProbe

Includes meter terminal block plug. Connects to a utility meter test block or to other current transformers.

Range: 10 mA - 10 A
Usable Bandwidth: DC - 3 kHz
Isolation: none
Burden: 0.01Ω

■ ***Figure 12-7*** *A-119 SmartProbe*

A-120 3000 Amp AC Clamp-on SmartProbe

Use this large probe for measuring high-current bus bars.

Range: 10 - 3000 A
Usable Bandwith: 30 - 3 kHz
Isolation: 4000 V
Jaw window: cable - 2.56 in (65mm);
bus bar - 1.97 x 5.31 in (50 x 135mm)
2.56 x 3.94 in (65 x 100mm)

■ ***Figure 12-8*** *A-120 SmartProbe*

For more information on supplies, accessories and warranties, contact BMI.

Accessories

- **A-018 Dual Probe Rack Mount Option**
  19" rack-mount option for one or two A-111, A-112, or A-009 probes.

- **A-201 PowerProfiler Rack Mount Option**
  19" rack mount option

- **G-010 PowerTalk Software**
  Powertalk provides software utilities for reviewing reports on IBM PC ATs, report writing and remote communication via RS-232 or modem. Includes cables and User's Guide. Supplied on both a 3.5" and a 5.25" diskette.

- **G-012 PowerProfiler Cart**
  Transports shipping cases, luggage.

- **G-201 Carry Bag**
  Heavy duty canvas bag with shoulder strap and zippered pockets.

- **G-202 Rugged Shipping Container**
  International orange for easy identification.

- **G-206 Internal Modem**
  Auto-dial, auto-answer 300/1200/2400 baud internal modem with cables and software. Must be factory installed.

Supplies

- **S-201 Paper**
  case of twelve rolls

- **S-502 Takeup Spools**
  box of 100

- **S-601 Diskettes**
  for 3060 PowerProfiler (set of 2)

- **Replacement cables and test leads**
  Contact Customer Support.

Warranty Extensions

One-year warranty extensions are offered for all BMI products.

Calibration Services

BMI offers a complete return-to-factory calibration service.

International:
Call 1-415 570-5355
FAX: 1-415 574-2176

BMI offers the following ongoing training courses for the PowerProfiler and for power quality issues. Classes are held at the BMI Training Center and at customer locations worldwide. Call for schedules.

- **C-155 The PowerProfiler: Use and Application**
  Achieving maximum results with the PowerProfiler: extensive hands-on work with power measurements, harmonics, energy costs, reporting, and use of PowerTalk software. Laboratory. 2 days.

- **C-175 Advanced Power Quality Lab**
  Careful analysis of particular power problems through hands-on observations on how disturbances propagate through building systems. Work with power conditioning equipment. 2 days.

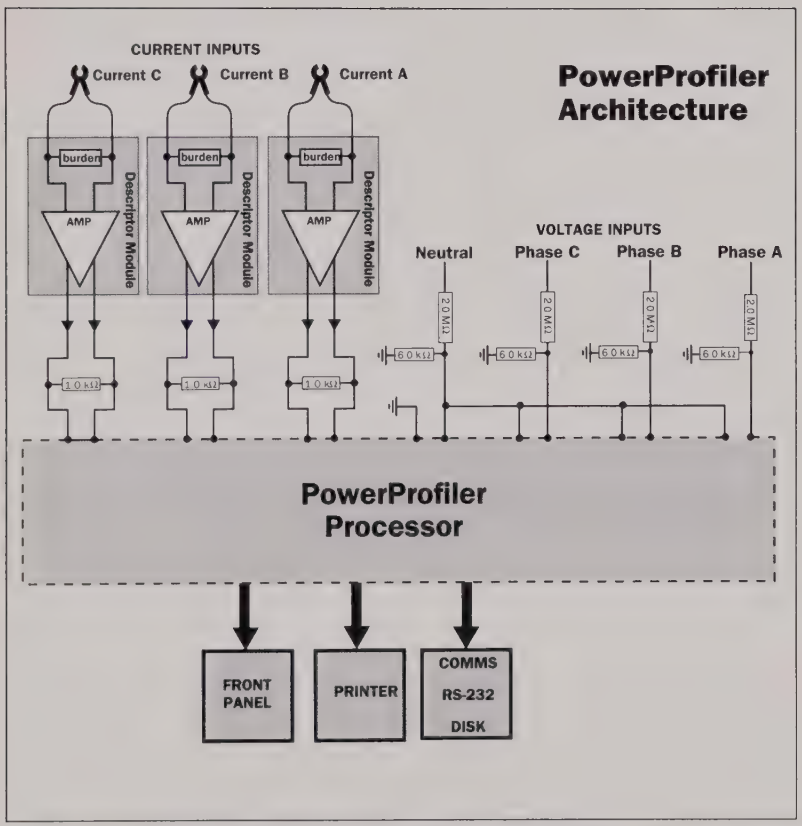
- **C-180 Power Management for Industry Professionals**
  Controlling energy costs through an understanding of power distribution, utility rate making and billing methods, methods for improving electrical equipment efficiency, time-of-use rate structures, demand limiting, power factor improvement, and the psychology of energy conservation. 3 days.

■ ***Figure 14-1*** *Training courses at BMI Training Center*

- **C-191R End Use Power Line Harmonics**
  Source and effects on the power system with typical problems and solutions. Subjects covered include the Fourier Series analysis, voltage versus current harmonics, neutral conductor overloading, parallel and series resonance problems, filter applications, transformer derating, measurement and standards. Classes held worldwide; call for latest schedule. 1 day.

- **A-019 complete Power Management Reference Library**
  This library is given to every C-180 class attendee, and also may be ordered separately.

Custom courses at your facility
These courses can be taught at your site. We can also customize a course to fit your needs.
Call 1-800 876-5355.



■ ***Figure 15-1*** To sample voltage and current simultaneously, three voltage and three current signals are routed through a multiplexer to a 14-bit analog-to-digital converter. At frequencies between 15 and 63 Hz, each cycle is sampled 128 times for 8 cycles worth of data. At frequencies between 280 and 500 Hz each cycle is sampled 16 times for 8 cycles worth of data. Digital data is passed to a CPU (80C186) and a co-processor (80C187) where the 7x1024 samples are processed every two seconds for three-phase, every second for single-phase. The CPU controls I/O operations, disk drive if installed, communications, printer, front panel keyboard, and meters.

15 Theory of Operation

Standard PowerProfiler Measurements

From the seven groups of 1024 sampled data points, the PowerProfiler computes: RMS Volts, RMS Amps, imbalance, true power factor (PF), and the power consumption in KW and VA every second for single-phase and every two seconds for three-phase. A Fast-Fourier Transform is performed every two seconds to give the Total Harmonic Distortion (THD), the harmonic spectrum for voltage and current up to the 50th harmonic, and the harmonic power spectrum and direction. Other measurements which depend on the harmonic analysis are also computed, such as displacement power factor (dPF), VARs, Telephone Interference Factor (TIF), and Transformer Derating. The data is automatically reduced by the computer into graphs for ease of understanding.

1. True RMS measurements

The PowerProfiler computes the RMS voltage and current over two cycles (256 data points) and calculates the True RMS value regardless of the shape of the waveform by taking the square root of the mean of the sum of the squares of the data points:

$$V_{rms} = \sqrt{\frac{\sum_{n=0}^{255} V_n^2}{256}} \qquad I_{rms} = \sqrt{\frac{\sum_{n=0}^{255} I_n^2}{256}}$$

2. Average voltage for three-phase

The average voltage for three-phase is calculated as the geometric mean of the three phases:

$$V_{total} = \sqrt{\frac{V_{rms\emptyset A}^2 + V_{rms\emptyset B}^2 + V_{rms\emptyset C}^2}{3}}$$

3. Total current for three-phase

The PowerProfiler gives the total RMS currents by adding all the individual phase RMS currents:

$$I_{total} = I_{rms\emptyset A} + I_{rms\emptyset B} + I_{rms\emptyset C}$$

4. Imbalance

The PowerProfiler takes the maximum difference in voltage (or current) magnitude between phases and divides by the average of the three

phases. Using voltage as an example:

$$V\ Imbalance = \frac{V_{max}}{V_{neut}} \times 100\%$$

5. Apparent Power (VA)

AC power in Volt-Amps (VA) is obtained by multiplying the RMS voltage by the RMS current:

$$VA = V_{rms} \times I_{rms}$$

6. Watts

True power in Watts is computed from the sum of each voltage point multiplied by its corresponding current point, integrated over the first 256 points. The PowerProfiler gives the true power including any harmonic distortion:

$$W = \frac{\sum_{n=0}^{255} V_n x I_n}{256}$$

7. Power Factor

True Power Factor (PF) is the ratio of true power to apparent power: This is the true power factor, regardless of any distortion in the voltage and current waveforms.

$$PF = \frac{W}{VA}$$

8. Displacement Power Factor (dPF)

Displacement power factor is the cosine of the displacement between the voltage and the current at the fundamental frequency: The PowerProfiler finds the angle between the voltage and current at the fundamental by harmonic analysis and then takes the cosine.

$$dPF = Cosine\ (\emptyset_{V\ fund} - \emptyset_{I\ fund})$$

Note: Power factor or Cos(Ø)?

Many people still think of and refer to Power Factor as Cosine Ø because they were taught that way. The Cosine Ø simplification can only be used

for a sine wave (one frequency, no harmonics). Displacement Power Factor is equal to the True Power Factor only for pure sine waves.

9. Reactive power (VAR)
The reactive power in VARs is computed as the Sine of the displacement between the voltage and current at the fundamental only:

$$VAR = VA \times \text{Sine}\,(\varnothing_{V\,fund} - \varnothing_{I\,fund})$$

10. Phasor diagrams
The PowerProfiler prints phasor diagrams at the fundamental frequency for voltage and current. Phasor diagrams are useful for showing phase rotation, imbalance, and verifying the PowerProfiler's voltage and current connections.

Demand Option (P-301) Measurements

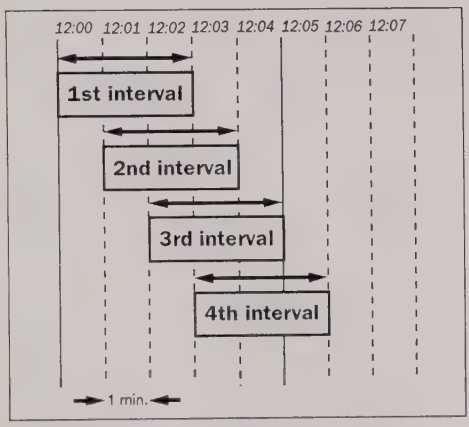
1. Efficiency
Two PowerProfilers connected together can measure electrical efficiency of devices such as transformers or uninterruptible power systems (UPS). With an RS-232 cable linking the two instruments, they will automatically calculate efficiency. The master PowerProfiler will report the efficiency in the meter window and print report graphs as required.

$$\text{Efficiency} = \frac{W_{out}}{W_{in}} \times 100\%$$

2. Cash flow
Using rate structures or tariffs power consumption is calculated in terms of cash flow; i.e., how much money is flowing along a conductor. The user enters either a flat rate or a time-of-day rate structure, and the Powerprofiler will graph the cash flow and keep a running total.

3. Billing demand and sliding interval
The billing demand report graph shows the power the same way that utilities meter power using peak-demand meters which average power consumption over an interval, usually 15 or 30 minutes. The PowerProfiler plots billing demand and account for billing demand charges in the cash report. Billing demand intervals between zero and 60 minutes may be programmed.

A variation on the billing demand interval is the sliding window interval when the utility continually moves the interval. The PowerProfiler accommodates slide times from 1 to 5 minutes.



■ ***Figure 15-2*** Sliding windows at one minute intervals

4. Load duration curve
The load-duration curve is a plot of the percentage of peak-demand against the percentage of time that the demand was used.

Harmonic Option (P-302) Measurements

1. Harmonics
Every two seconds (every one second for single-phase) the PowerProfiler performs a harmonic analysis by the Fast Fourier Transform (FFT) method and gives the magnitude and the phase angle of each harmonic up to the 50th harmonic. The magnitude of each harmonic can be expressed as a percentage of fundamental or as voltage or current. The harmonic analysis results are used to calculate the following parameters: Total Harmonic Distortion (THD), transformer-derating, Telephone Interference Factor (TIF), and sequencing (positive, zero, and negative sequences for voltage and current.)

2. Total Harmonic Distortion (THD)
THD is calculated as follows:

$$V_{THD} = \frac{\sqrt{\sum_{n=2}^{50} h_n^2}}{h_1} \quad x\ 100\%$$

3. Transformer Derating Factor (Z)
At 180 Hz the efficiency of a transformer drops from 96% to 70% and is lower with higher frequency. Current harmonics can overheat and even destroy transformers. An algorithm has been developed (ANSI/IEEE C57.110-1986, 5.3) which gives a "derating factor" to determine the maximum permitted load taking the harmonics into account. The PowerProfiler calculates derating using this algorithm.

4. Telephone Interference Factor (TIF or IT)
The TIF algorithm weights each harmonic according to a formula based on the band-pass characteristics of telephone systems and the frequency response of the human ear. The PowerProfiler calculates the telephone interference factor which results current harmonics.

$$IT = \left(\sum_{n=1}^{H} (I_n T_n) \right)^{\frac{1}{2}}$$

T_n = telephone interference weight factor from tables.

5. Harmonic Power Direction
The PowerProfiler also finds the direction of flow of harmonic power for each harmonic using harmonic phase angle information.

6. Positive, Zero, and Negative Sequences
The PowerProfiler calculates and displays in the meter window positive, negative, and zero sequences for voltage and current at the fundamental frequency.

Neutral Option (P-303) Measurements

Neutral Voltage and Current
The PowerProfiler measures the actual neutral-to-ground voltage (when there is one) and calculates the neutral current from the phase currents. This is valid when there is no leakage in the system. To confirm the actual neutral current the instrument can be set up for single-phase and the current measurement made on the neutral conductor. If the Harmonic Option Package P-302 is installed, the PowerProfiler will calculate the neutral current harmonic spectrum.

Note: Three-phase delta metering neutral
There are four voltage inputs and a ground connection terminal to the PowerProfiler. In applications where no neutral conductor exists – as in a three-phase-delta configuration – the PowerProfiler references the measurements to ground. Using software, the PowerProfiler constructs a metering neutral at the center of the three phases. A metering neutral is a mathematical neutral used to calculate power measurements in a delta system. Also, in delta configurations the PowerProfiler can calculate the third phase current if it knows the other two currents.

SmartProbe Measurements

SmartProbes measure current
The PowerProfiler uses SmartProbes to measure current. SmartProbes are up to ten times more accurate than conventional current probes. Each SmartProbe consists of a current transformer and a descriptor module. Inside the descriptor module is a programmable precision current source. The gain of the current source is adjusted to compensate for any deviations in current transformer output as result of the transformer manufacturing process or variations in burden and cable resistance. The descriptor module precisely calibrates the current transformer and provides the correct voltage level to the PowerProfiler. Three SmartProbes are available with full-scale measuring ranges of 60, 600, and 3000 amps.

Ranges	Voltage	Current
Without multiplier	0 - 600 Vrms (±1000 Vpk)	0 - 3000 Arms
With multiplier	0.6 mV - 600 MV	<1 mA - 3 GA
User-supplied multipliers for use with CTs and PTs	.0001 - 999999	.0001 - 999999
Fundamental Frequency (for harmonic analysis)	25 - 450 Hz	25 - 450 Hz

General

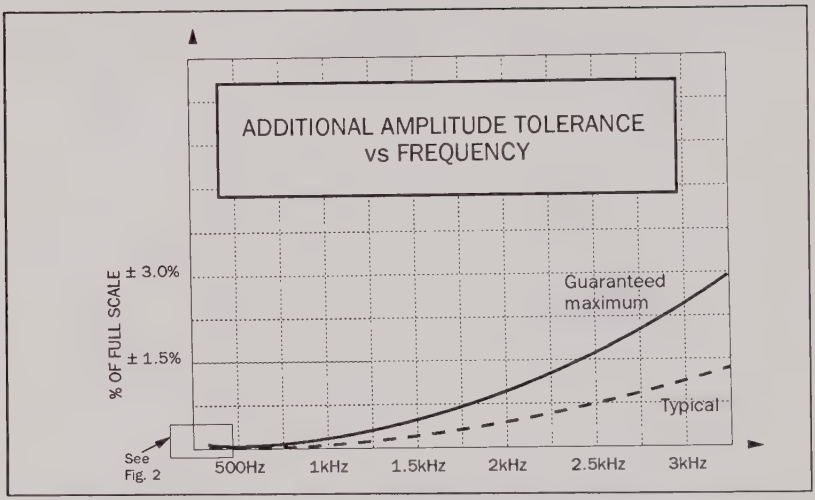
Physical	14.6 x 13.0 x 5.7 in (37 x 33 x 14.5 cm) (L x W x H)	17 lb (7.6 kg)
Power	80 - 150 Vac, 160 - 270 Vac, 45 - 450 Hz, 100 VA max UPS: internal nicad batteries, 15 minutes	
Environmental	**Temperature**	**Humidity**
Operating	0°C - 50°C	95% noncondensing
Storage	-40°C - 75°C	95% noncondensing
Shock/Vibration	30 g's of shock, vibration per MIL-T-28800C	
Testing, Approvals	CSA, UL pending	

Input Characteristics	Voltage	Current
Type	solid state differential DC coupled	BMI SmartProbe with software calibration and amplifier in probe
Impedance	2 MΩ to ground <50 pF to ground	
Dielectric	>2.5 kV to chassis	
Connectors	standard high voltage safety connectors	BMI SmartProbe

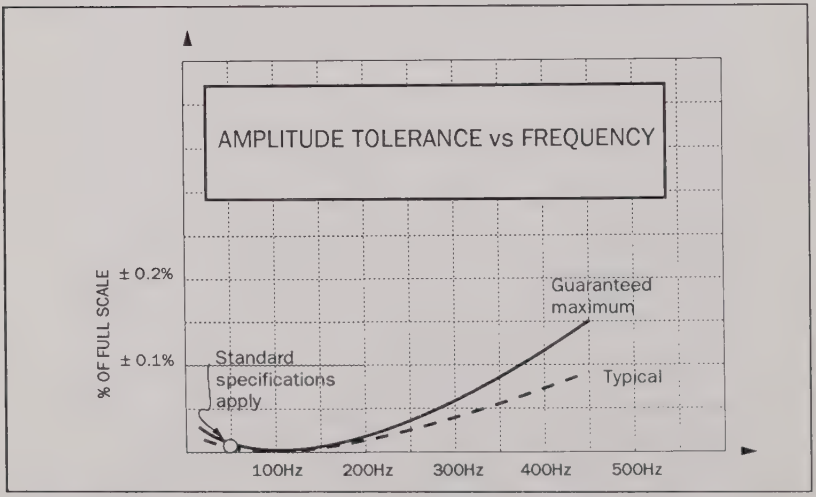
Accuracy		ACCURACY AT 50/60 Hz	USEFUL BANDWIDTH
Voltage Accuracy:		±0.01% full scale ±0.1% of reading	DC - 3 kHz
Current Accuracy:			
A-115	(60 A)	±0.03% of full scale ±0.1% of reading	45 Hz - 65 Hz
A-116	(600 A)	±0.01% of full scale ±0.1% of reading	45 Hz - 3 kHz
A-119	(CTIP)	±0.01% of full scale ±0.05% of reading	25 Hz - 3 kHz
A-120	(3000 A)	±0.01% of full scale ±0.1% of reading	45 Hz - 3 kHz

Specifications at 20°C, 50/60 Hz, 5% F.S. - 60% F.S. Temperature coefficient ±200 ppm F.S./°C, drift less than 10 ppm F.S./day, warmup time to rated accuracy: 60 minutes, noise less than 0.05% Rms full scale, resolution ±0.5 display count. See pages 66-67 for accuracy at other frequencies. Specifications subject to change without notice.

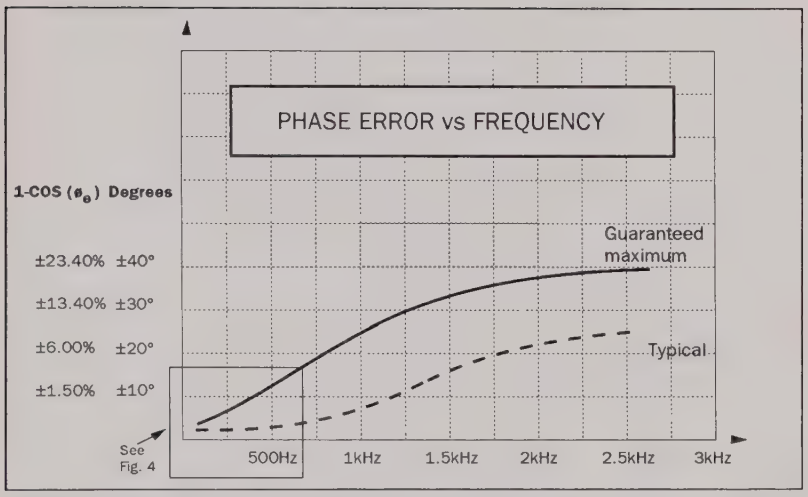
16 Specifications



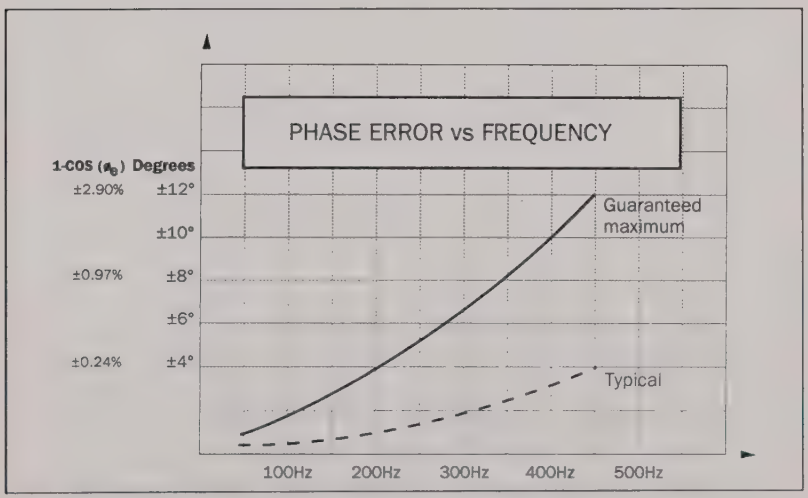
■ ***Figure 1*** *Amplitude error vs frequency. Conditions: phase-locked signal, amplitude at frequency of interest > 10% full-scale, ± 0.5 display digit, firmware revision 3.0 or later, current conductor centered in jaw. A-115 not specified.*



■ ***Figure 2*** *Enlarged view of the boxed area in Figure 1*



■ ***Figure 3*** *Phase error vs frequency. Conditions: phase-locked signal, amplitude at frequency of interest > 10% full-scale, ± 0.5 display digit, firmware revision 3.0 or later, current conductor centered in jaw. A-115 not specified.*



■ ***Figure 4*** *Enlarged view of the boxed area in Figure 3*

When is your PowerProfiler or SmartProbe out of calibration?

When your PowerProfiler and your SmartProbes are calibrated, every graph that prints out will show a BMI logo.

The BMI logo will disappear, and the words (uncalibrated data.) will appear when:

1. **The unit has passed its calibration due date**
   Generally, your BMI units should be calibrated every year.
2. **One or more of your SmartProbes is out of calibration**

To identify the reason for uncalibrated data, simply press CALIBRATE. The printout will describe the status of your unit and SmartProbes. See the next two pages for sample calibration reports showing a unit in calibration and a unit out of calibration.

BMI's Annual Calibration Service

BMI offers full calibration services for any BMI instrument. Calibration is guaranteed and traceable (NIST). Call Customer Service for details on getting your PowerProfiler calibrated by BMI.

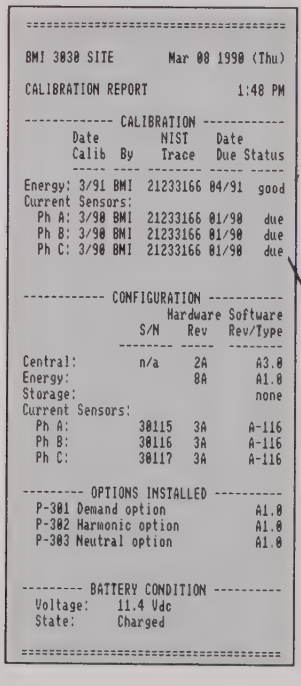
Calibrating at your site

If you have the resources to do your own calibration, BMI can provide you with calibration instructions. Call BMI Customer Service. You will need the following test equipment:

1. A single AC voltage source capable of at least 200 Vrms at 50 or 60 Hz
2. A stable current source capable of at least 100 Arms at 50 or 60 Hz
3. A 5 digit voltage/current meter
4. 3 SmartProbe channel special connectors You will need to solder these connections. Order BMI Part #50606110 from BMI customer service.

17 Calibration

Press CALIBRATE to get the following printout.
This printout shows reasons why your unit may be out of calibration.

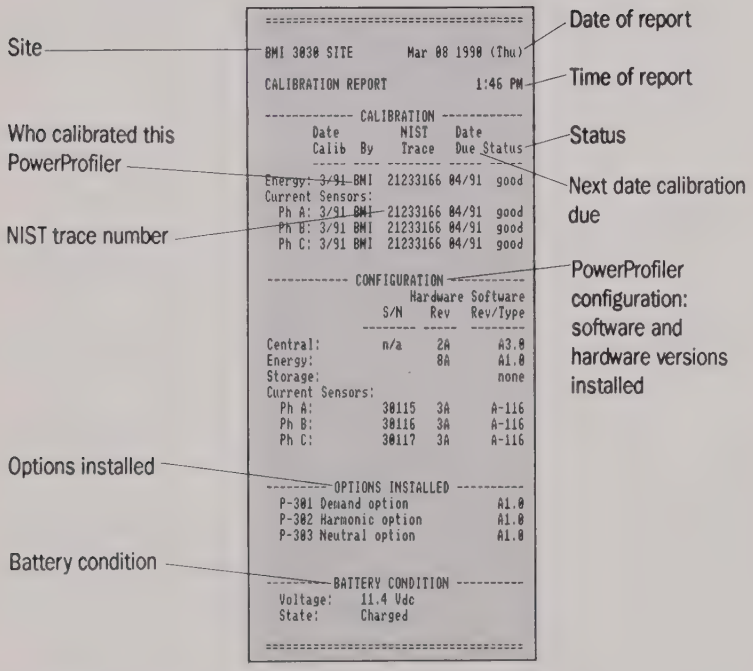


```
=======================================

BMI 3030 SITE        Mar 08 1990 (Thu)

CALIBRATION REPORT                1:48 PM

------------- CALIBRATION ------------
       Date          NIST    Date
       Calib  By     Trace   Due Status
       ----- ---- --------- ----- ------
Energy: 3/91 BMI  21233166 04/91  good
Current Sensors:
  Ph A: 3/90 BMI  21233166 01/90   due
  Ph B: 3/90 BMI  21233166 01/90   due
  Ph C: 3/90 BMI  21233166 01/90   due


------------ CONFIGURATION -----------
                    Hardware Software
                S/N    Rev   Rev/Type
              -------- -----  --------
Central:        n/a     2A       A3.0
Energy:                 8A       A1.0
Storage:                         none
Current Sensors:
  Ph A:         30115   3A       A-116
  Ph B:         30116   3A       A-116
  Ph C:         30117   3A       A-116

--------- OPTIONS INSTALLED ----------
  P-301 Demand option              A1.0
  P-302 Harmonic option            A1.0
  P-303 Neutral option             A1.0


--------- BATTERY CONDITION ----------
  Voltage:    11.4 Vdc
  State:      Charged

=======================================
```

One or more of your SmartProbes is out of calibration (On this report, all three SmartProbes need calibration).

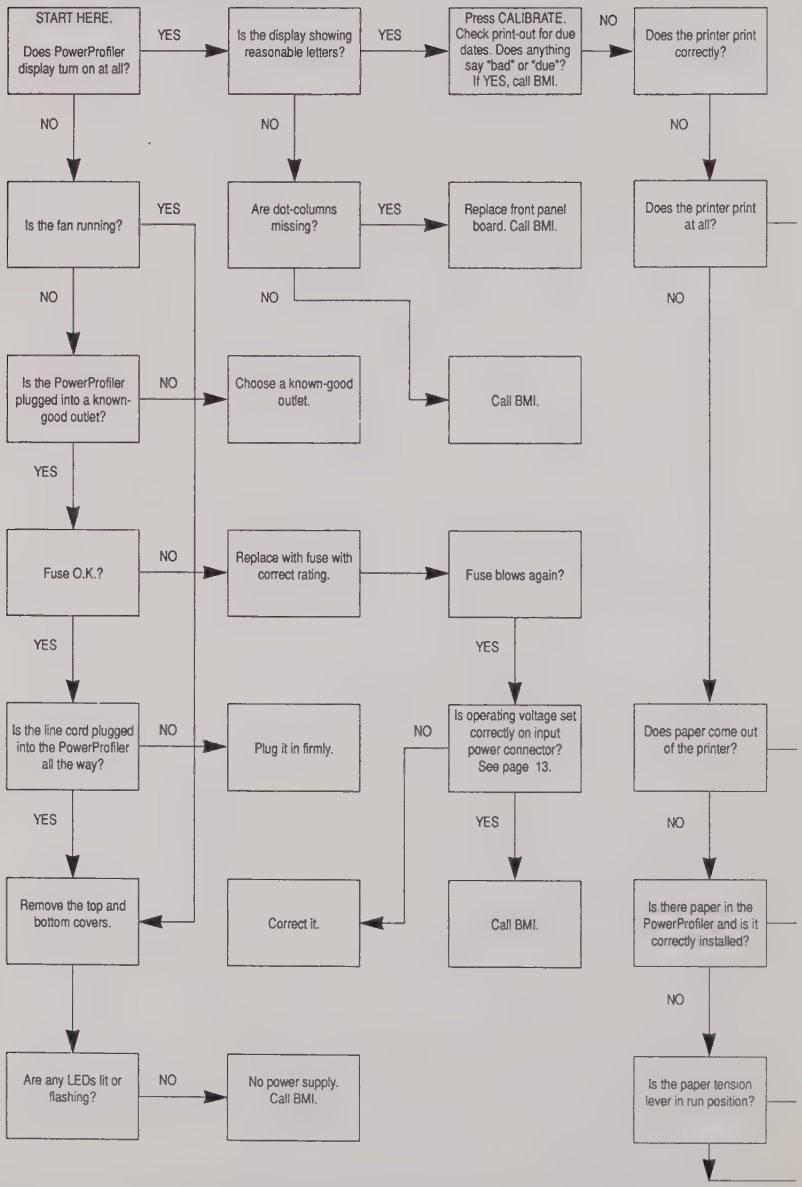
■ ***Figure 1*** *This calibration report shows the PowerProfiler is in calibration (status: good), but SmartProbes are out of calibration (status "due" = bad).*

Sample Calibration Report



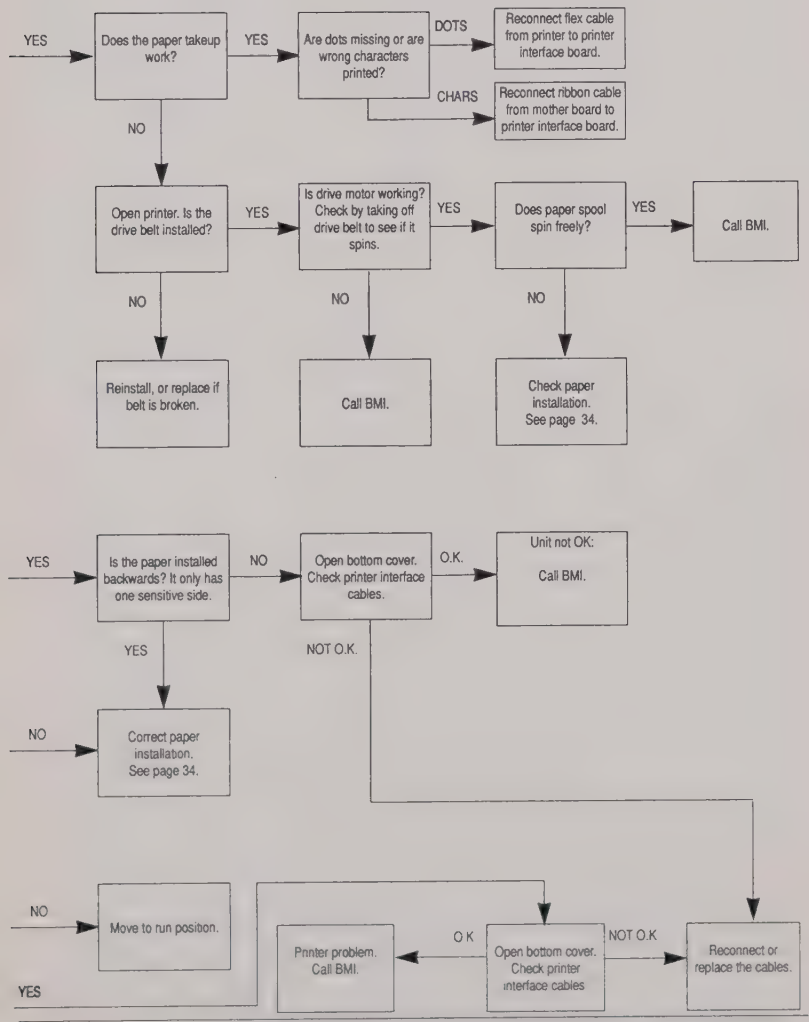
■ ***Figure 2*** *Calibration report showing PowerProfiler and SmartProbes in calibration (Status: good)*

18 Troubleshooting



PowerProfiler Troubleshooting Chart

Use this chart to narrow down the possible causes of any problem with your PowerProfiler. Call BMI's Customer Service Department if you need help: In the U.S., 1-800 888-2648; Main number, 1-415 570-5355; TWX, 1-910-374-3059; FAX 1-415 574-2176.

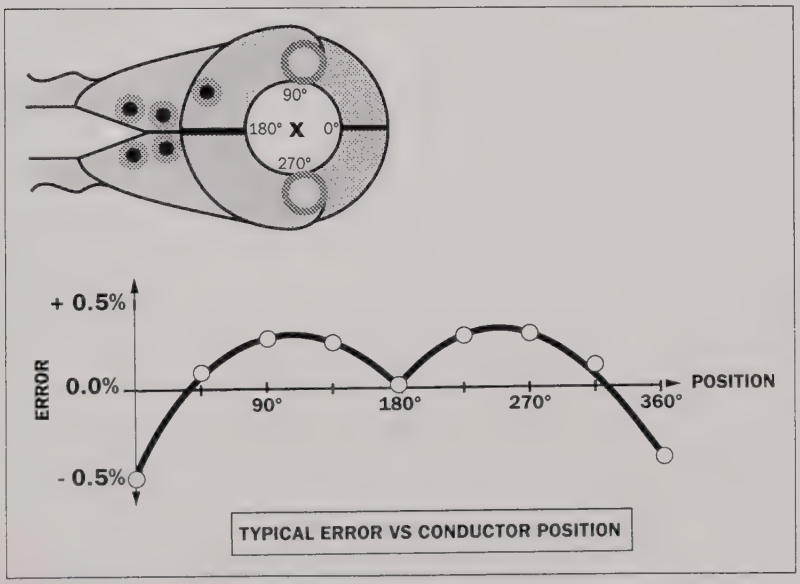


Sources of SmartProbe current errors

The principal sources of current measurement errors with A-116 and A-120 SmartProbes are conductor position, conductor angle, and mating of clamp-on jaw. The descriptions below apply to the A-116, but the principles apply to all clamp-on current probes.

Conductor Position

The A-116 SmartProbe has its accuracy specified with the conductor positioned in the center of the jaws (position **X** in figure 1). The following diagram and graph show how the accuracy varies with conductor position for the A-116 600 Amp SmartProbe.



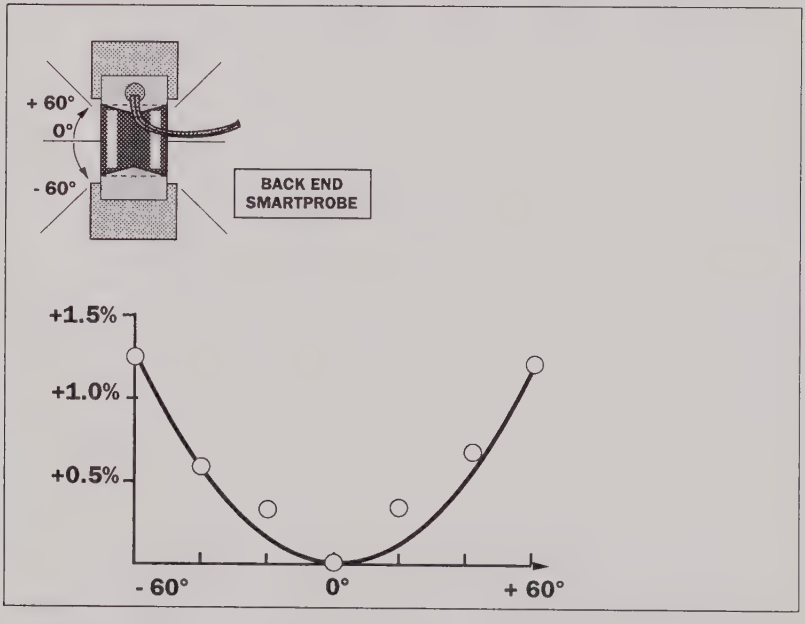
■ ***Figure 1*** *Typical error vs conductor position with the following test qualifications:*

- *A-116 SmartProbe, calibrated at 200A, 60Hz*
- *Error expressed as percent of reading*
- *Test @ 16A, 60 Hz*
- *Conductor perpendicular to plane of jaw*
- *Normalized to centered conductor = 0.0%*

19 SmartProbe Accuracy

Conductor Angle

The A-116 SmartProbe has its accuracy specified with the conductor positioned at 90° to the jaws. The following diagram and graph show how the error varies with conductor angle.

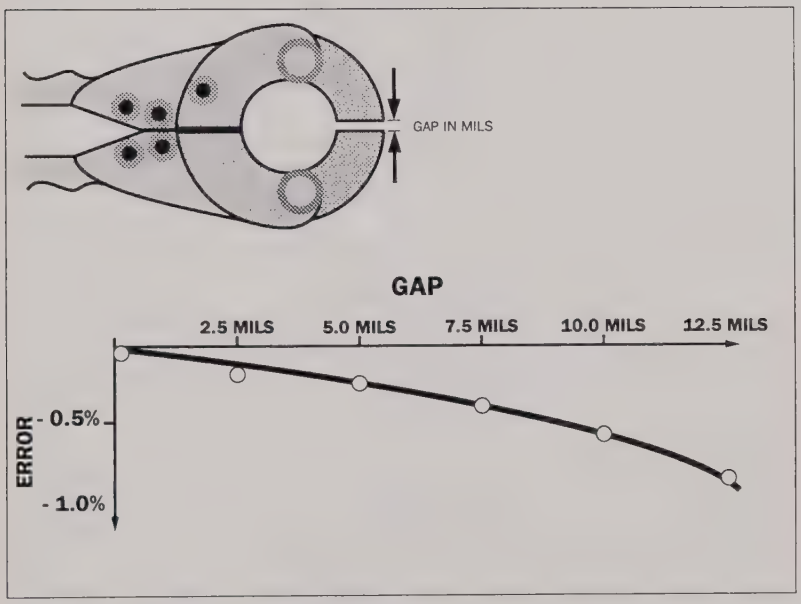


■ ***Figure 2*** *Error vs conductor angle*

- *A-116 SmartProbe, calibrated @ 200 A, 60 Hz*
- *Test @ 20A, 60 Hz*
- *Conductor passes through center point of jaw*
- *Error as percent of reading*

Mating of clamp-on jaw

Errors will also be introduced if the jaws do not mate properly. The following graph shows how the error varies with the gap between jaws for the A-116 600 Amp SmartProbe.



■ ***Figure 3*** *Typical error vs jaw gap*

- *A-116 SmartProbe, calibrated @ 200A, 60Hz*
- *Error as percent of reading*
- *Test @ 16A, 60Hz, normalized to 0.0% @ ø gap*

Power Consumption Reports

INSTANTANEOUS POWER (W AND VA)

Site name (entered in Setup Menu)

```
========================================
BMI 3030 SITE        Jan 01 1990 (Mon)

POWER CONSUMPTION REPORT

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)


----------------------------------------
BMI 3030 SITE        Jan 01 1990 (Mon)

INSTANTANEOUS POWER          MIDNIGHT

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)

Total:
   MAX:      1.2 MW
          8:19 PM Dec 27 1989 (Wed)
   MIN:      0.1 MW
          5:35 AM Dec 30 1989 (Sat)

Phase A-N:
   MAX:      0.8 MW
         12:48 AM Dec 29 1989 (Fri)
   MIN:     -0.8 MW
          1:38 AM Dec 30 1989 (Sat)
Phase B-N:
   MAX:      0.4 MW
          4:39 PM Dec 31 1989 (Sun)
   MIN:      0.0 MW
          7:24 PM Dec 31 1989 (Sun)
Phase C-N:
   MAX:      1.2 MW
          8:19 PM Dec 27 1989 (Wed)
   MIN:      0.0 MW
          5:35 AM Dec 30 1989 (Sat)
```

Date report issued

Interval of time this report covers. (This is an example of a weekly report.)

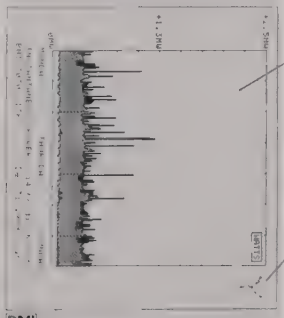
Time this report was issued

Maximum value recorded in this report interval

Minimum value recorded in this report interval

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

This format is the same for instantaneous power (W) and instantaneous apparent power (VA).



Graphical summary report for this report interval

Indicates PowerProfiler was set up for three-phase, 4 wire

```
INSTANTANEOUS POWER (ACCUMULATED):
   MAX:1301484.5 W
          9:34 AM Dec 13 1989 (Wed)
   MIN:  52092.8 W
          5:35 AM Dec 30 1989 (Sat)
```

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and data and records were cleared

20 Reading Reports

Power Consumption Reports, cont'd

CASH FLOW AND TOTAL POWER CONSUMPTION

Site name (entered in Setup Menu)

Type of report (Cash flow)

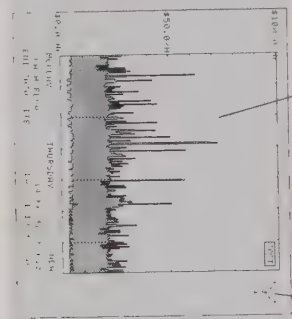
```
BMI 3030 SITE          Jan 01 1990 (Mon)
CASH FLOW                    12:00:25 AM

  FROM: MIDNIGHT Dec 24 1989 (Sun)
  To:   MIDNIGHT Dec 31 1989 (Sun)

Total:
  MAX:   $ 72.98 /Hr
         8:19 PM Dec 27 1989 (Wed)
  MIN:    $ 3.13 /Hr
         5:35 AM Dec 30 1989 (Sat)
```

Date report was issued

Time report was issued

Interval of time this report covers

Maximum and minimum values recorded during this report interval



Graphical summary report for this report interval

Indicates PowerProfiler was set up for three-phase, 4 wire

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

```
BMI

CASH FLOW (ACCUMULATED):
  MAX:   $ 78.09 /Hr
         9:34 AM Dec 13 1989 (Wed)
  MIN:    $ 3.13 /Hr
         5:35 AM Dec 30 1989 (Sat)
```

Total power consumption report begins

```
BMI 3030 SITE          Mar 31 1990 (Sat)
TOTAL POWER CONSUMPTION      12:01:06 AM

  FROM: MIDNIGHT Dec 24 1989 (Sun)
  To:   MIDNIGHT Dec 31 1989 (Sun)

FLAT RATE:   Cost:   $ 0.120/kWh
             Cost:   $ 5.000/kWpk

  BILLING DEMAND:
          1.855 kW    Pk Today
          1.760 kW    Pk Accumulated
        $ 5.275       Today
        $ 8.800       Accumulated
  CONSUMPTION:
         17.88 kWh    Today
        263.3 kWh     Accumulated
        $ 2.850       Today
        $ 31.50       Accumulated

         17.64 kQh    Today
         24.17 kVARh  Today
```

Cost of electricity (entered in Rate Structure Menu)

Maximum peak power value recorded during this report interval

Total WH recorded since monitoring began or since PowerProfiler was reset and reports were cleared (k = kilo)

Maximum peak power value recorded since monitoring began or since PowerProfiler was reset and reports were cleared

Total WH recorded for this report interval (M = mega)

Total cash spent for this report interval

Power Consumption Reports

BILLING DEMAND

Site name (entered in Setup Menu)

Type of report

Indicates demand interval, sliding interval, and synchronization values (entered in Rate Structure Menu)

```
BMI 3030 SITE          Jan 01 1990 (Mon)
BILLING DEMAND                 12:00:15 AM
   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)
   DEMAND INTERVAL:     15 min
   SLIDING INTERVAL:    No
   SYNCHRONIZATION:     None
Total:
   MAX:    165.7 kW
         12:19 PM Dec 27 1989 (Wed)
   MIN:     38.4 kW
          3:49 AM Dec 31 1989 (Sun)
Phase A-N:
   MAX:     15.1 kW
          2:19 AM Dec 28 1989 (Thu)
   MIN:     -0.0 kW
          1:49 AM Dec 30 1989 (Sat)
Phase B-N:
   MAX:     66.2 kW
         10:34 AM Dec 28 1989 (Thu)
   MIN:     16.4 kW
         10:49 AM Dec 31 1989 (Sun)
Phase C-N:
   MAX:    140.4 kW
         12:19 PM Dec 27 1989 (Wed)
   MIN:     18.8 kW
         11:04 AM Dec 27 1989 (Wed)
```

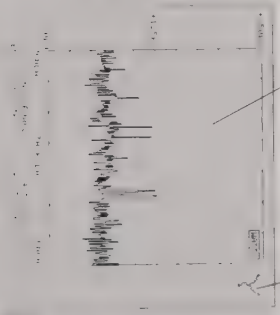
Date report was issued

Time report was issued

Interval of time this report covers

Maximum and minimum values recorded during this report interval

Maximum and minimum values recorded for individual phases during this report interval



Graphical summary report for this report interval

Indicates PowerProfiler was set up for three-phase, 4-wire

```
BMI

BILLING DEMAND (ACCUMULATED):
   MAX: 284850.9 W
          9:34 AM Dec 05 1989 (Tue)
   MIN:  38392.5 W
          3:49 AM Dec 31 1989 (Sun)
```

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

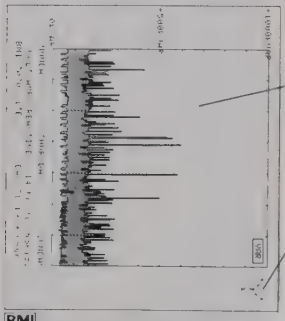
20 Reading Reports

Power Factor Reports

POWER FACTOR REPORTS

This format is the same for Volt-Amps Reactive (VAR), Displacement Power Factor (dPF) and True Power Factor (PF).

```
========================================
BMI 3030 SITE        Jan 01 1990 (Mon)

POWER FACTOR REPORT

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)


----------------------------------------
BMI 3030 SITE        Jan 01 1990 (Mon)

VOLT-AMPS REACTIVE          12:00:39 AM

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)

Total:
   MAX:    599.9 kVAR
         2:07 AM Dec 28 1989 (Thu)
   MIN:   -150.6 kVAR
         6:59 PM Dec 29 1989 (Fri)

Phase A-N:
   MAX:    469.6 kVAR
        12:48 AM Dec 29 1989 (Fri)
   MIN:      0.0 kVAR
        12:31 AM Dec 25 1989 (Mon)
Phase B-N:
   MAX:     66.0 kVAR
        4:38 PM Dec 25 1989 (Mon)
   MIN:     -9.9 kVAR
        8:42 PM Dec 25 1989 (Mon)
Phase C-N:
   MAX:    550.8 kVAR
        8:15 PM Dec 27 1989 (Wed)
   MIN:   -161.4 kVAR
        6:59 PM Dec 29 1989 (Fri)
```



```
BMI

INSTANTANEOUS VOLT-AMPS (ACCUMULATED):
   MAX: 669045.3 VAR
         10:41 AM Dec 20 1989 (Wed)
   MIN:-150636.8 VAR
         6:59 PM Dec 29 1989 (Fri)
```

Date report was issued

Time report was issued

Interval of time this report covers

Maximum and minimum values recorded during this report interval

Maximum and minimum values recorded for individual phases during this report interval

Graphical summary report for this report interval

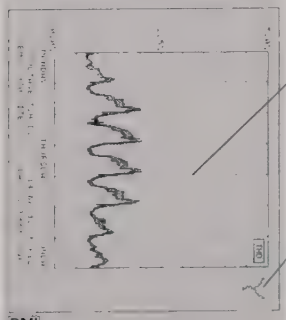
Indicates PowerProfiler was set up for three-phase, 4 wire

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

HARMONIC REPORTS

Site name
Type of report

```
========================================
BMI 3030 SITE          Jan 01 1990 (Mon)

HARMONICS REPORT

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)


----------------------------------------
BMI 3030 SITE          Jan 01 1990 (Mon)

VOLTAGE T.H.D.                12:01:00 AM

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)

Average:
   MAX:       2.1% THD
           8:31 PM Dec 28 1989 (Thu)
   MIN:       0.7% THD
          10:16 AM Dec 25 1989 (Mon)

Phase A-N:
   MAX:       2.0% THD
           8:58 PM Dec 27 1989 (Wed)
   MIN:       0.4% THD
           5:24 AM Dec 28 1989 (Thu)
Phase B-N:
   MAX:       2.3% THD
           8:31 PM Dec 28 1989 (Thu)
   MIN:       1.0% THD
          10:46 PM Dec 30 1989 (Sat)
Phase C-N:
   MAX:       2.0% THD
           7:39 PM Dec 27 1989 (Wed)
   MIN:       0.7% THD
          10:15 AM Dec 25 1989 (Mon)
```




```
VOLTAGE T.H.D. (ACCUMULATED):
   MAX:       2.4% THD
           8:35 PM Nov 27 1989 (Mon)
   MIN:       0.7% THD
          10:16 AM Dec 25 1989 (Mon)
```

This format is the same for Voltage THD, Current THD, and Individual Harmonic Reports.

Date of report

Time of report

Interval of time this report covers

Maximum and minimum values of THD recorded during this report interval (average of all phases)

Maximum and minimum values recorded during this report interval for individual phases

Graphical summary report for this report interval

Indicates PowerProfiler was set up for three-phase, 4 wire

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

20 Reading Reports

Voltage and Current Reports

VOLTAGE AND CURRENT

Site name

Type of report

```
BMI 3030 SITE          Jan 01 1990 (Mon)
VOLTAGE                        12:01:57 AM

   FROM: MIDNIGHT Dec 24 1989 (Sun)
   To:   MIDNIGHT Dec 31 1989 (Sun)

Average:
   MAX:      1.5 kV
          7:06 PM Dec 28 1989 (Thu)
   MIN:      1.4 kV
          7:29 AM Dec 26 1989 (Tue)

VOLTAGE IMBALANCE:
   MAX:      1.5%
          6:52 PM Dec 29 1989 (Fri)
   MIN:      0.2%
          1:54 AM Dec 27 1989 (Wed)

Phase A-N:
   MAX:      1.5 kV
          7:17 PM Dec 27 1989 (Wed)
   MIN:      1.4 kV
          7:29 AM Dec 26 1989 (Tue)
Phase B-N:
   MAX:      1.5 kV
          7:06 PM Dec 28 1989 (Thu)
   MIN:      1.4 kV
          7:24 AM Dec 26 1989 (Tue)
Phase C-N:
   MAX:      1.5 kV
          7:06 PM Dec 28 1989 (Thu)
   MIN:      1.4 kV
          7:29 AM Dec 26 1989 (Tue)
```

Date report was issued

Time report was issued

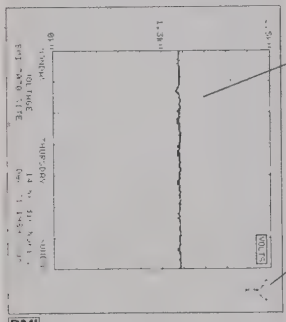
Interval of time this report covers

Maximum and minimum values of imbalance recorded during this report interval

Maximum and minimum average values of all phases recorded during this report interval (total for current)

Maximum and minimum values recorded during this report interval for individual phases

This format is the same for all voltage and current



Graphical summary report for this report interval (average of all phases)

Indicates PowerProfiler was set up for three-phase, 4 wire

```
VOLTAGE (ACCUMULATED):
   MAX:   1484.8 V
          7:18 PM Dec 12 1989 (Tue)
   MIN:   1398.8 V
          7:51 PM Nov 25 1989 (Sat)

VOLTAGE IMBALANCE (ACCUMULATED):
   MAX:      5.0%
          7:51 PM Nov 25 1989 (Sat)
   MIN:      0.1%
          7:51 AM Dec 10 1989 (Sun)
```

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

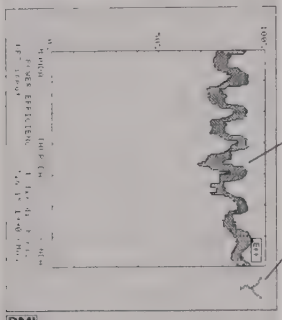
Effficiency Reports

EFFICIENCY

Site name

Type of report

```
==========================================
BMI 3030 SITE          Jan 15 1990 (Mon)

EFFICIENCY REPORT

   FROM: MIDNIGHT Jan 07 1990 (Sun)
   To:   MIDNIGHT Jan 14 1990 (Sun)


------------------------------------------
BMI 3030 SITE          Jan 15 1990 (Mon)

POWER EFFICIENCY              12:01:35 AM

   FROM: MIDNIGHT Jan 07 1990 (Sun)
   To:   MIDNIGHT Jan 14 1990 (Sun)

Total:
   MAX:     94.3% Eff
          4:16 AM Jan 14 1990 (Sun)
   MIN:     67.9% Eff
          3:47 PM Jan 11 1990 (Thu)

   INPUT POWER:   UPS input
   OUTPUT POWER:  UPS output
```



```
BMI

EFFICIENCY (ACCUMULATED):
   MAX:     96.8% Eff
          2:21 AM Dec 31 1989 (Sun)
   MIN:     67.9% Eff
         11:38 AM Jan 05 1990 (Fri)
==========================================
```

Date report was issued

Time report was issued

Interval of time this report covers

Maximum and minimum values of efficiency recorded during this report interval

Graphical summary report for this report interval

Indicates PowerProfiler was set up for three-phase, 4 wire

Maximum and minimum values recorded since monitoring began or since PowerProfiler was reset and reports were cleared

Menus

MENUS ■ ***Press the MENUS key to get to Menu Selections.***

Menu Selections		
Menu:	Setup	*See Page 87 for this menu.*
	Rate Structure	*See Page 88 for this menu.*
	Harmonics	*See Page 90 for this menu.*
	Set Thresholds	*See Page 91 for this menu.*
	Communication	*See Page 93 for this menu.*
	Storage	*See Page 95 for this menu.*
	Environmental	*See Page 96 for this menu.*

Key to Menu symbols

Site: *Each of these is a menu selection.*

Use the SCROLL keys to move down, up, right or left through menu selections.

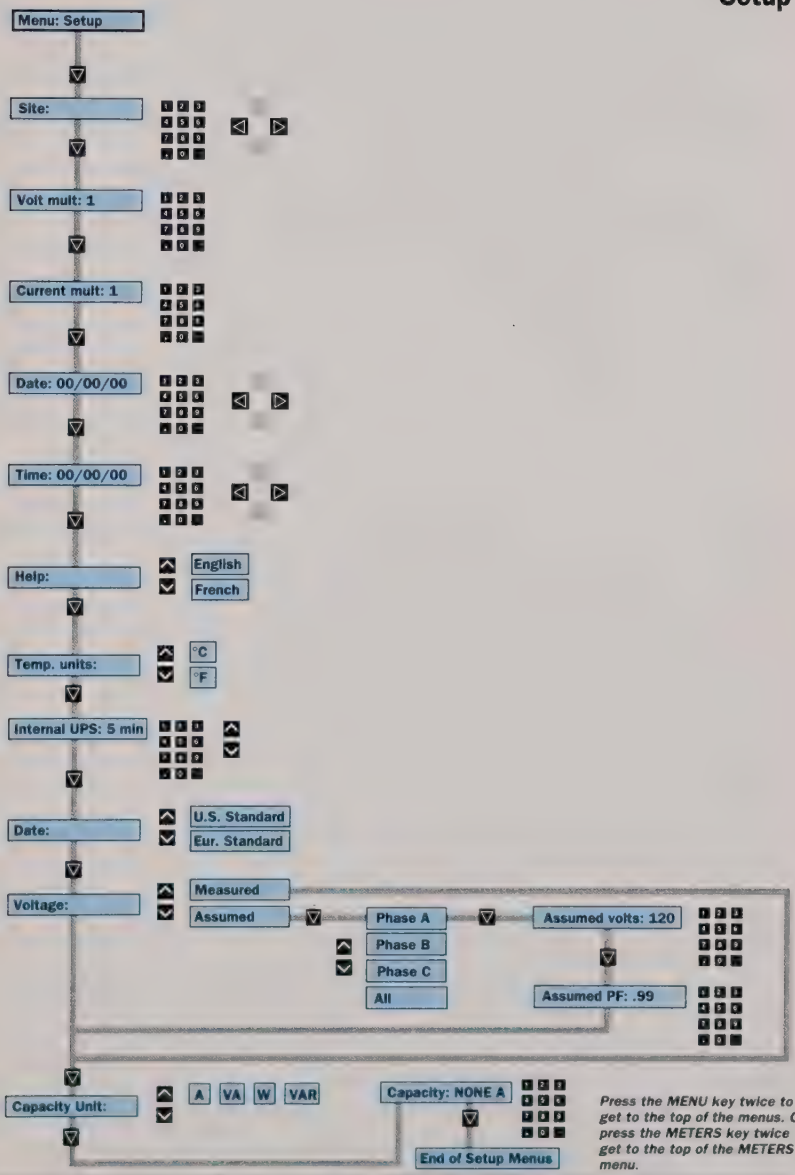
Use the down SCROLL key to move to the next menu selection.

Use the VALUE UP/VALUE DOWN keys to select a menu or to enter information.

Use the number/letter keypad to enter information. For example, to enter the letter 'B' push the '2ABC' key three times.

*Use the **HELP!** key at any time for further assistance.*

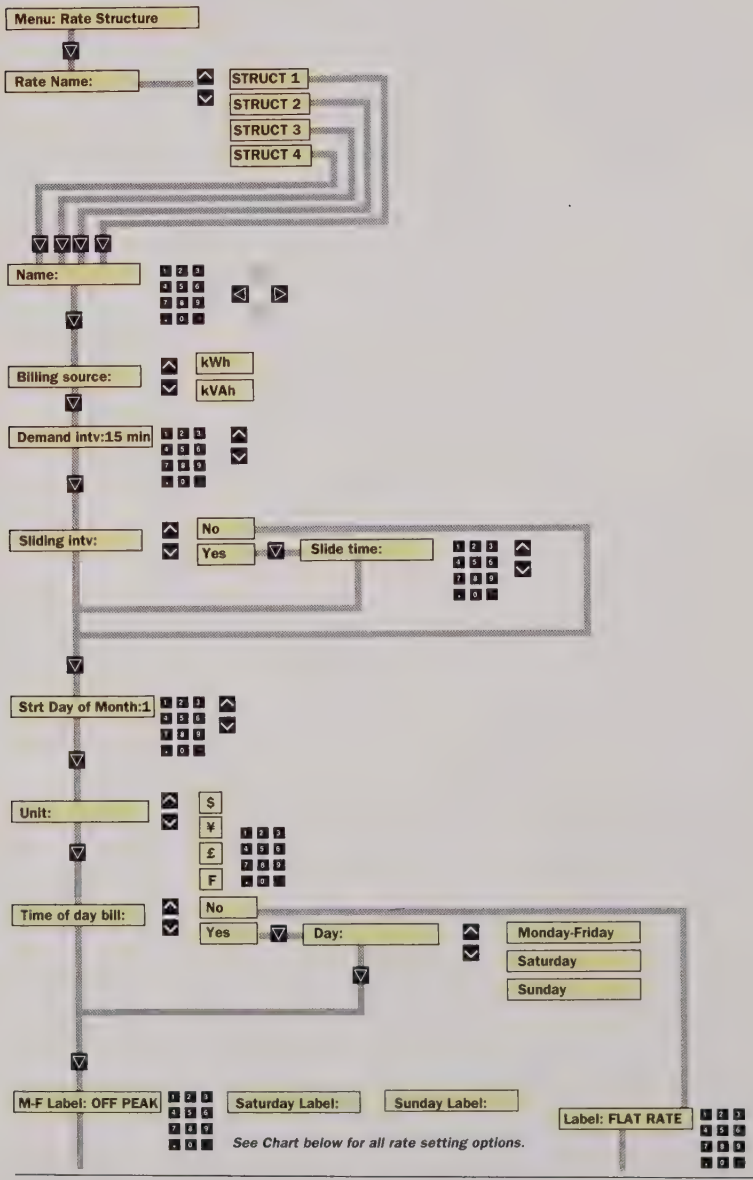
*Our Customer Service Engineers can also help. **Call 1-800 888-2648.***

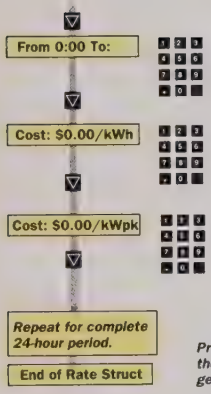


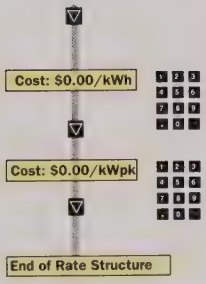
Press the MENU key twice to get to the top of the menus. Or press the METERS key twice to get to the top of the METERS menu.

Menus

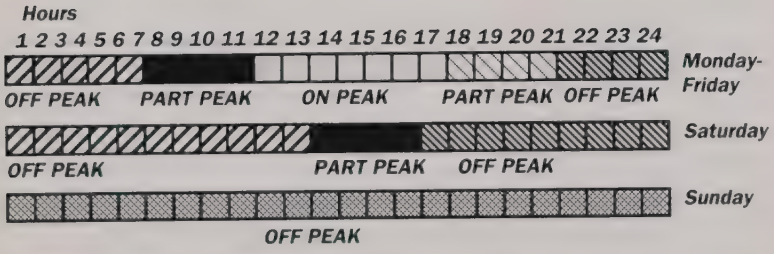
Rate Structure







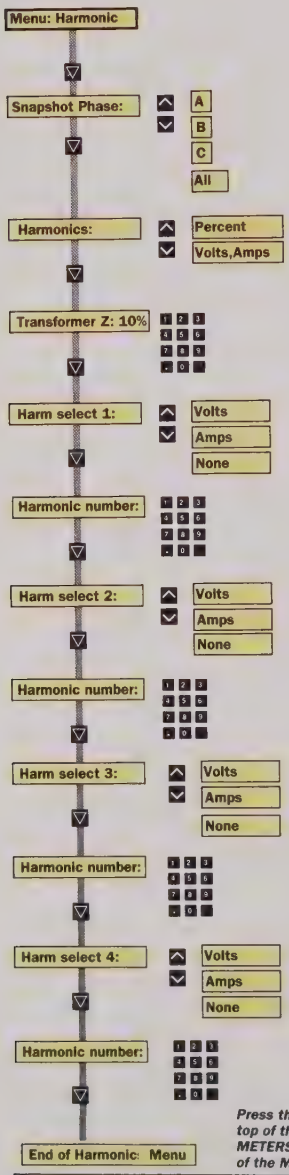
Press the MENU key twice to get to the top of the menus. Or press the METERS key twice to get to the top of the METERS menu.



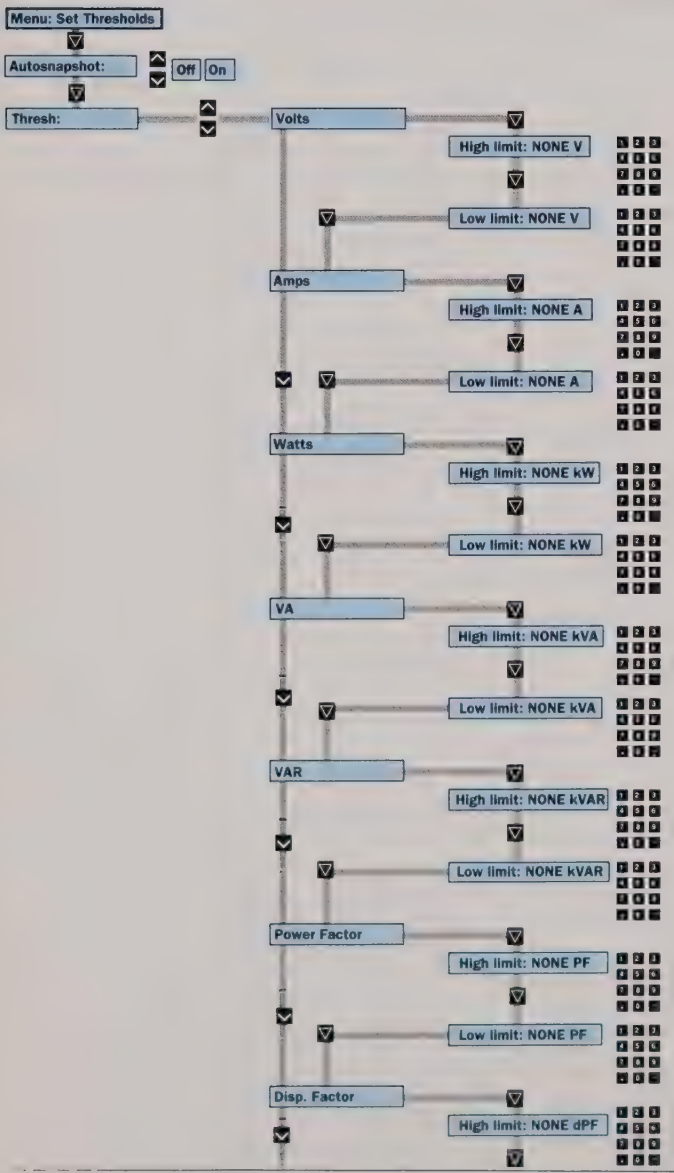
Default settings for rate structures. For example, you can select up to five different times for Monday-Friday; you can set up your own hours and your own names.

Menus

Harmonic

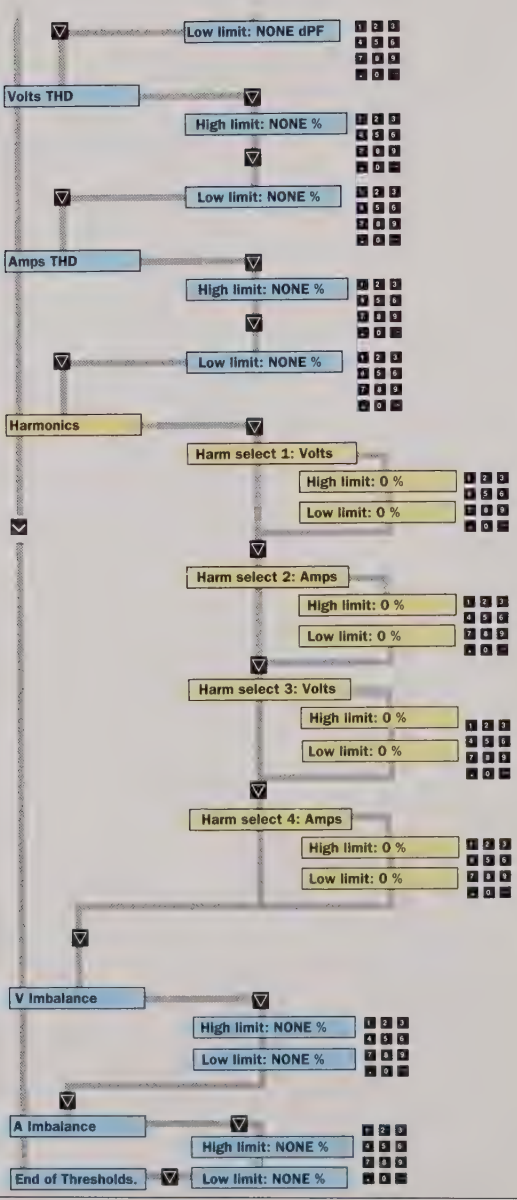


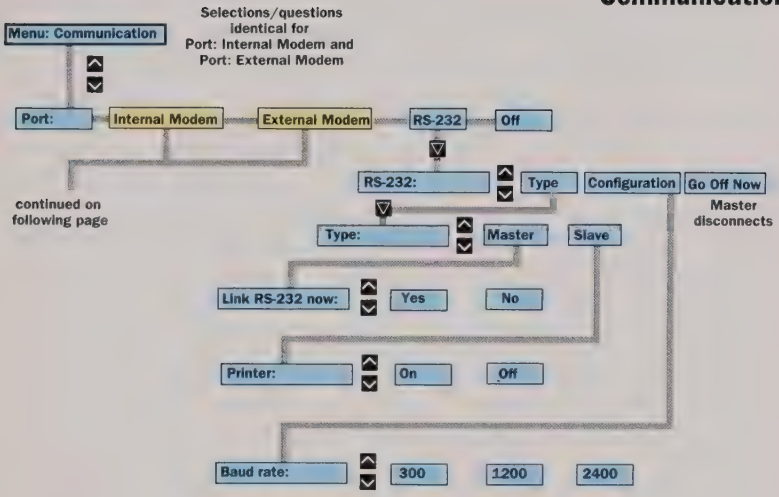
Press the MENU key twice to get to the top of the menus. Or press the METERS key twice to get to the top of the METERS menu.


Menu: Set Thresholds
Autosnapshot:
Off
On
Thresh:
Volts
High limit: NONE V
Low limit: NONE V
Amps
High limit: NONE A
Low limit: NONE A
Watts
High limit: NONE kW
Low limit: NONE kW
VA
High limit: NONE kVA
Low limit: NONE kVA
VAR
High limit: NONE kVAR
Low limit: NONE kVAR
Power Factor
High limit: NONE PF
Low limit: NONE PF
Disp. Factor
High limit: NONE dPF

Menus

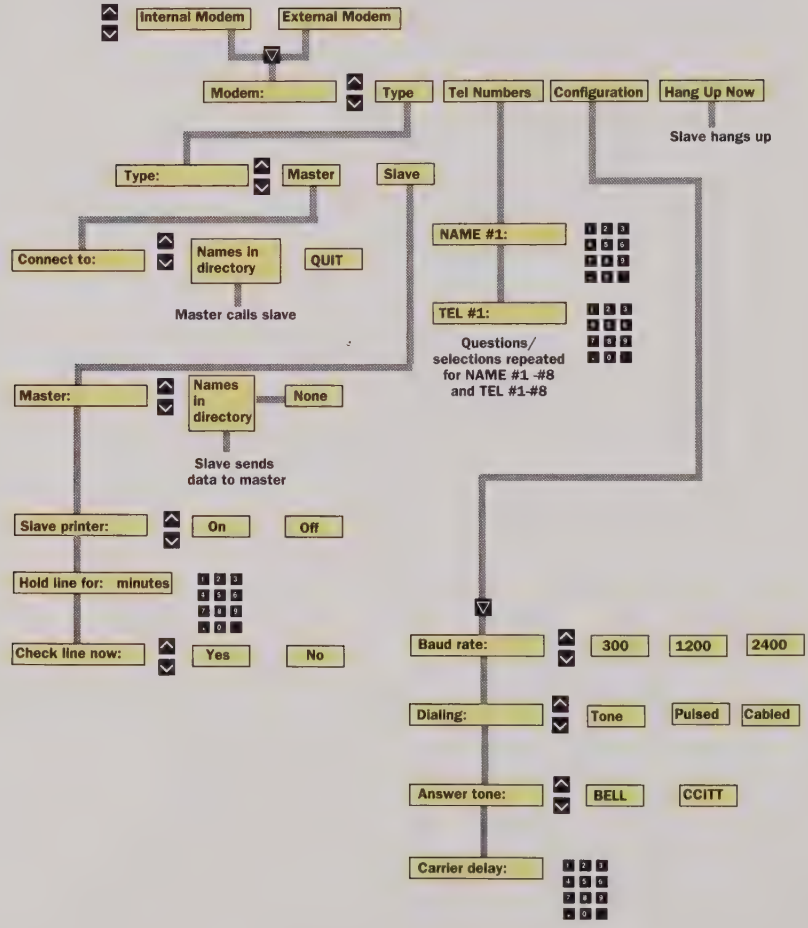
Set Thresholds

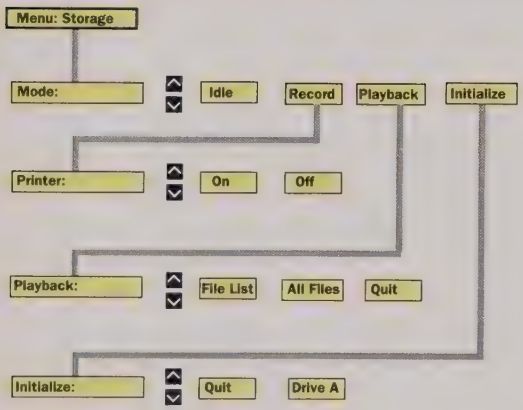



Menu: Communication
Selections/questions identical for Port: Internal Modem and Port: External Modem
Port:
Internal Modem
External Modem
RS-232
Off
continued on following page
RS-232:
Type
Configuration
Go Off Now
Master disconnects
Type:
Master
Slave
Link RS-232 now:
Yes
No
Printer:
On
Off
Baud rate:
300
1200
2400

Menus

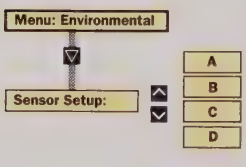
Communication



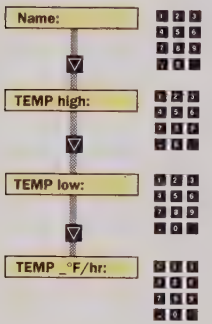

Menu: Storage
Mode:
Idle
Record
Playback
Initialize
Printer:
On
Off
Playback:
File List
All Files
Quit
Initialize:
Quit
Drive A

Menus

Environmental

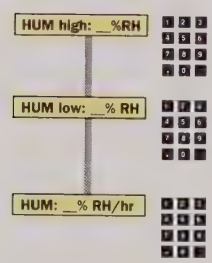


Temperature Probe

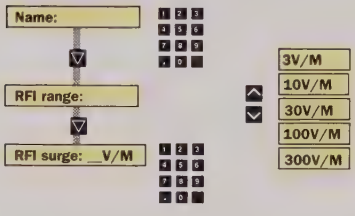


Temperature/Humdity Probe

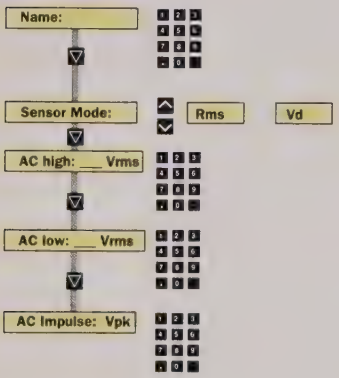
Repeat questions for Temperature Probe, then:



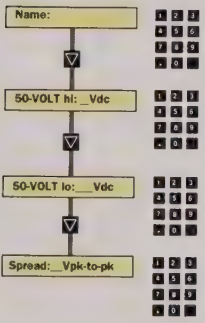
Radio Frequency Interference Probe



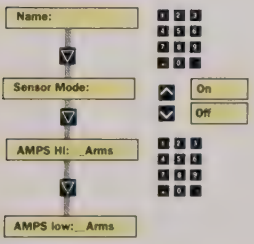
AC/DC/Impulse Probe



50-Volt Proportional Supply Probe



Current Probe



Meters

Bold type: Standard
Light type: Options (These will not show up unless you have the option installed.)

Single Phase

Phase A-N: 0.0 V
Phase A: 0.0 A
Phase A-N: 0.0 W
Phase A-N: 0.0 VA
Phase A-N: 0.0 VAR
Phase A-N: 0.0 PF
Phase A-N: 0.0 dPF
A Current Lags(Leads): 0°
A-N Volts: 0.0% THD
A Current: 0.0% THD
Derate xfmr to: 0%
A Current TIF: 0 k
A harmonic
A harmonic
Capacity: 0.0% Cap
Efficiency: 0.0% Eff
Cost: $0.000/hr
Frequency: 60. Hz
Time: 0:00:00

Single Phase, 3-wire

Average: 0.0 V
Total: 0.0 A
Total: 0.0 W
Total: 0.0 VA
Total: 0.0 VAR
Total: 0.00 PF
Total: -0.0 dPF
< - - - Current lead/lag - - >
Avg. Volts: 0.0% THD
Avg. Curr: 0.0% THD
Derate xfmr to: 0%
Current TIF: 0
Avg harmonic
Avg harmonic
Avg harmonic
Avg harmonic
Total: 0.0% Cap
Efficiency
Cost: $0.000/hr
Frequency 60.0 Hz
Time: 0:00:00

Phase A-N: 0.0 V
Phase A: 0.0 A
Phase A-N: 0.0 W
Phase A-N: 0. 0 VA
Phase A-N: 0.0 VAR
Phase A-N: 0.00 PF
Phase A-N: 0.0 dPF
A Current (Lags)Leads 0°
A-N Volts: 0.0% THD
A Current: 0.0% THD
<-Derate xfmr- - - -
A Current TIF: 0
A harmonic
A harmonic
A harmonic
A harmonic
< - Capacity - - - - >
Efficiency
< - Cost - - - ->
< - Frequency - - - - >
Time: 0:00:00

Phase B-N: 0.0 V
Phase B: 0.0 A
Phase B-N: 0.0 0 W
Phase B-N: 0.0 VA
Phase B-N: 0.0 VAR
Phase B-N: 0.00 PF
Phase B-N: 0.0 dPF
B Current Lags(Leads) 0°
B-N Volts: 0.0% THD
B Current: 0.0% THD
<- - Derate xfmr- - - >
B Current TIF: 0
B harmonic
B harmonic
B harmonic
B harmonic
B harmonic
< - - Capacity - - ->
Efficiency
< - - Cost - - - >
< - - Frequency - - - >
Time: 0:00:00

The following tables contain the meter readings for each power type as displayed by the 3030.

After selecting your power type, you can move freely through the available meter readings using the scroll keys.

The readings scroll up and down, right and left through the display in the order shown here.

Use the Up/Down scroll keys to move vertically with a column, and the Right/Left scroll keys to move side-to-side.

Neut-Gnd: 0.0 V->	**V Imbalance: 0.0%**	
Neutral: 0.00 A	**A Imbalance: 0.0%**	
<-Power->	**<- -Power->**	
<-Volt-Amps - - >	**<- -Volt_Amps->**	
<-VA Reactive - - >	**<- - VA Reactive->**	
<-Power Factor- ->	**<- - Power Factor->**	
<-Disp. Factor- ->	**<- -Disp. Factor->**	
< - Current lead/lag - - - >	**< - - Current lead/lag - - >**	
<-Volt THD->	**<-Volt THD->**	
N Current 0.0% THD	**<-Curr THD->**	
<- - - Derate xfmr- - ->	<- - - -Derate xfmr->	
<-Curr TIF - - >	<- - Curr TIF - - >	
< - Harmonics - >	< - Harmonics - >	
< - Harmonics - >	< - Harmonics - >	
< - Harmonics - >	< - Harmonics - >	
< - Harmonics - >	< - Harmonics - >	< - - - Capacity - - >
< - - - - Capacity - >		
Efficiency	Efficiency	
< - - - Cost - - >	< - - - - Cost - - >	
< - - - Frequency - - >	**< - - - - Frequency - - >**	
Time: 0:00:00	**Time: 0:00:00**	

Meters

Three Phase, 3-wire

Average: 0.0 V	**Phase A-B: 0.0 V**	**Phase B-C: 0.0 V**
Total: 0.0 A	**Phase A: 0.0 A**	**Phase B: 0.0 A**
Total: 0.0 W	**< - Power - - - - >**	**< - - Power - - - >**
Total: 0.0 VA	**< - Volt_Amps - - - - >**	**< - - Volt_Amps - - - >**
Total: 0.0 VAR	**< - VA Reactive- - - - >**	**< - - VA Reactive - - - >**
Total: 0.00 PF	**< - Power Factor - - - - >**	**< - - Power Factor - - - >**
Total: 0.00 dPF	**< - Disp. Factor - - - - >**	**< - - Disp. Factor - - - >**
< - - Curr lead/lag ->	**A Current (Lags)Leads: 0°**	**B Current (Leads)Lags: 0°**
Vol Pos Seq: 0.0%	Volt Zero Seq: 0.0%	Volt Neg Seq: 0.0%
Curr Pos Seq: 0.0%	Curr Zero Seq: 0.0%	Curr Neg Seq: 0.0%
Avg. Volts: 0.0% THD	**A-N Volts: 0.0% THD**	**B-N Volts: 0.0% THD**
Avg. Curr: 0.0% THD	**A Current: 0.0% THD**	**B Current: 0.0% THD**
Derate xfmr to: 0%	< - Derate xfmr - - - - >	< - - Derate xfmr - - - >
Current TIF: 0.0k	A Current TIF: 0.0k	B Current TIF: 0.0k
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Total: 0.0% Cap	< - Capacity - - - - >	< - - Capacity - - - >
Efficiency	< - Efficiency - - - - >	< - - Efficiency - - - >
Cost: $0.000/hr	< - Cost - - - - >	< - - Cost - - - >
Frequency:	**< - Frequency - - - - >**	**< - - Frequency - - - >**
Time: 0:00:00	**Time: 0:00:00**	**Time: 0:00:00**

Phase C-A: 0.0 V	**V Imbalance: 0.0%**
Phase C: 0.0 A	**A Imbalance: 0.0%**
<- - - Power - - >	**< - - - - Power - - >**
<- - - Volt_Amps - - >	**< - - - - Volt_Amps - - >**
<- - - VA Reactive - - >	**< - - - - VA Reactive - - >**
<- - - Power Factor - - >	**< - - - - Power Factor - - >**
<- - - Disp. Factor - - >	**< - - - - Disp. Factor - - >**
C Current (Leads)Lags: 0°	**< - - Curr lead/lag - - >**
< - Volt Seq - - >	< - - Volt Seq - - >
< - Curr Seq - - >	< - - Curr Seq - - >
C-A Volts: 0.0% THD	**< - Volt THD - - >**
C Current: 0.0% THD	**< - Curr THD - - >**
<- - - Derate xfrm - - >	< - - - - Derate xfmr - - >
C Current TIF: 0 k	< - Curr TIF - - >
C harmonic	< - Harmonics - - >
C harmonic	< - Harmonics - - >
C harmonic	< - Harmonics - - >
C harmonic	< - Harmonics - - >
<- - - Capacity - - >	< - - - - Capacity - - >
Efficiency N/A	Efficiency N/A
<- - - Cost - - >	< - - - - Cost - - >
<- - - Frequency - - >	**< - - - - Frequency - - >**
Time: 0:00:00	**Time: 0:00:00**

Meters

Three Phase, 4-wire

Average: 0.0 V	**Phase A-N: 0.0 V**	**Phase B-N: 0.0 V**
Total: 0.0 A	**Phase A: 0.0 A**	**Phase B: 0.0 A**
Total: 0.0 W	**Phase A-N 0.0 W**	**Phase B-N 0.0 W**
Total: 0.0 VA	**Phase A-N 0.0 VA**	**Phase B-N 0.0 VA**
Total: 0.0 VAR	**Phase A-N 0.0 VAR**	**Phase B-N 0.0 VAR**
Total: 0.00 PF	**Phase A-N 0.0 PF**	**Phase B-N 0.0 PF**
Total: 0.00 dPF	**Phase A-N 0.0 dPF**	**Phase B-N 0.0 dPF**
<- - - Curr lead/lag ->	**A Current (Leads) Lags: 0°**	**B Current (Leads)Lags: 0°**
Vol Pos Seq: 0.0%	Volt Zero Seq: 0.0%	Volt Neg Seq: 0.0%
Curr Pos Seq: 0.0%	Curr Zero Seq: 0.0%	Curr Neg Seq: 0.0%
Avg. Volts: 0.0% THD	**A-N Volts: 0.0% THD**	**B-N Volts: 0.0% THD**
Avg. Curr: 0.0% THD	**A Current: 0.0% THD**	**B Current: 0.0% THD**
Derate xfmr to: 0%	< - Derate xfmr - - - - - >	< - - Derate xfmr - - - - >
Current TIF: 0.0k	A Current TIF: 0.0k	B Current TIF: 0.0k
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Avg harmonic	A harmonic	B harmonic
Total: 0.0% Cap	< - Capacity - - - - - >	< - - Capacity - - - - >
Efficiency	Efficiency	Efficiency
Cost: $0.000/hr	< - Cost - - - - >	< - - Cost - - - >
Frequency:	**< - Frequency - - - - >**	**< - - Frequency - - - >**
Time: 0:00:00	**Time: 0:00:00**	**Time: 0:00:00**

Phase C-N: 0.0 V	Neut-Gnd: 0.0 V
Phase C: 0.0 A	Neutral 0.0 A
Phase C-N 0.0 W	< - Power - - >
Phase C-N 0.0 VA	< - Volt_Amps - - >
Phase C-N 0.0 VAR	< - VA Reactive - - >
Phase C-N 0.0 PF	< - Power Factor - - >
Phase C-N 0.0 dPF	< - Disp. Factor - - >
C Current (Leads)Lags: 0°	< - Curr lead/lag - >
< - Volt Seq - - - >	< - - Volt Seq - - >
< - Curr Seq - - - >	< - - Curr Seq - - >
C-N Volts: 0.0% THD	< - Volt THD - - >
C Current: 0.0% THD	N Current 00.0% THD
<- - - Derate xfrm - - - >	< - - - - Derate xfmr - >
C Current TIF: 0 k	< - Curr TIF - - >
C harmonic	< - Harmonics - >
C harmonic	< - Harmonics - - >
C harmonic	< - Harmonics - - >
C harmonic	< - Harmonics - - >
<- - - Capacity - - - >	< - - - - Capacity - - >
Efficiency	Efficiency
<- - - Cost - - - >	< - - - - Cost - - >
<- - - Frequency - - - >	**< - - - - Frequency - - >**
Time: 0:00:00	**Time: 0:00:00**

Capacity
The fraction of a supply's resources that are being used, expressed as a percentage of capacity in amps, volt-amps, or watts. The user enters both the units of capacity (amps, volt-amps, or watts) and the total capacity in the Setup Menu. Displayed in the meter readings.

Cash flow
The cost per hour (expressed in dollars, yen, pounds, francs, or user-selected designation) of the power flowing in the conductor or conductors being measured by the PowerProfiler. Requires user input of price information such as a utility rate structure entered in the Rate Structure menu. Displayed in the meter readings and the Power Consumption report.

Crest factor
The ratio of the peak instantaneous voltage or current to the RMS voltage or current. For a sine wave, this is approximately 1.4.

High crest factors may imply the presence of harmonics. Low crest factors may imply an overloaded transformer. Protective devices such as circuit breakers and fuses may not operate correctly with high crest factors. Catastrophic insulation breakdowns and premature aging of motors, switchgear, and electronics may also be attributable to high crest factors. Displayed in the voltage and current snapshot.

Current
True RMS current; that is, the root of the mean of the squares of the instantaneous current; gives correct readings for sine waves, distorted waveforms, offset waveforms, and DC (with DC probes). True RMS measurements are necessary to determine overheating of transformers and wiring due to non-linear loads such as ASDs (adjustable speed drives), motor controllers, high efficiency lighting, electric vehicle chargers, arc furnaces, etc.

Demand
In its simplest form, demand is the rate of energy consumption (power) measured in watts. A demand interval—typically 15 or 30 minutes—is the average power consumed during the interval. A sliding demand interval advances the beginning and end points of the interval. Utility companies typically choose sliding intervals between 1 and 5 minutes.

Glossary

dPF (displacement power factor - cosine ø)
The cosine of the angle between the fundamental voltage and the fundamental current. Displayed in the meter readings and the Power Factor report. This is a traditional approximation of the true power factor; however, it is inaccurate for distorted waveforms.

Efficiency
The power efficiency of a system, expressed in percent. If 8 megawatts feeds into a distribution transformer, and 7.6 megawatts comes out, the transformer is 95% efficient. (Note: this measurement requires two PowerProfilers; place one instrument on the input of the system, and the other on the output. The instruments can be connected by RS-232 cable or modem.) Displayed in meter readings and the Efficiency report and snapshot.

Form Factor (F)
The ratio of average voltage or current to root-mean-square (RMS) voltage or current. For example, a sine wave has a Form Factor of 1.1, while a square wave has a Form Factor of 1.0. The Form Factor is used as a constant in calculations for magnetic flux density (ß) and magnetomotive force (MMF) in transformer design.

Harmonic spectrum
The harmonic spectrum shows the magnitude of each harmonic frequency that makes up a distorted waveform. The magnitude of each harmonic frequency can be expressed as a percentage of the fundamental or as a voltage or current value. The harmonic spectrum also shows how far each of the frequencies are shifted by phase angle with respect to the fundamental. Displayed in harmonic snapshot.

The magnitude of up to four individual harmonics may be selected for study. Useful for sizing and siting harmonic filters. Individual harmonic magnitudes are displayed in the meters and the harmonic reports.

Imbalance
A measure of the difference between RMS voltage (or current) in each phase. For example, if each phase is carrying the same current, and each phase is 120° from adjacent phases, the current is "perfectly balanced" and the current imbalance is 0%. Displayed in the Voltage and Current meters snapshot and report. It is possible in 3-phase systems to

have imbalance; e.g., when one phase is lightly loaded.

Load Duration Curve
A curve showing the number of hours that a certain demand was equalled or exceeded over an hour, day, week, or month. This is useful to show how much load must be shifted to reduce the peak demand or how much interruptible capacity is available. Displayed in the Power Consumption report.

Metering neutral (Nm)
The metering neutral is a mathematically calculated reference point on a 3-phase 3-wire system. It is used to calculate power and phase angles on individual phases. It is independent of the grounding scheme; it works equally well with corner-grounded, center-grounded, and mid-phase grounded systems. Without it, voltages and currents cannot be associated; for example, should the Phase A to Phase B voltage be associated with the current in Phase A, or the current in Phase B? A metering neutral allows calculations to be made on the Phase A to Metering neutral voltage, which is always associated with the Phase A current.

Phasor diagrams
A graphic representation of the relationship between phase and amplitude for poly-phase voltages or currents. Applies to the fundamental voltage and current. Displayed in the Voltage and Current snapshot.

Quantity (Qh)
Q is an arbitrary measurement unit used by some utilities in Q-Hour meters instead of kWh meters. Q-Hour meters shift the currents by 60° leading to obtain more accurate measurements of kVA and VAR when power factor is between 0.9 and unity.

Telephone interference factor (IT, TIF)
Telephone interference factor. This is equivalent to the frequency spectrum of the voltage (or current) waveform, weighted according to the response of the telephone system and the human ear. It is a partial measure of how likely a distorted utility voltage waveform will interfere with a telephone system. Values less than 10K are unlikely to interfere; values from 10K to 50K may interfere; values greater than 50K probably

will interfere with local telephone operation. The PowerProfiler calculates TIF due to current, sometimes expressed as IT.

The voltage IT (or TIF) couples through electric fields and is not usually a problem in a low voltage industrial facility. The current IT (or TIF) couples through magnetic fields, and is especially important near high harmonic loads such as arc welders, adjustable speed drives, UPS's, etc. Displayed in the meter readings.

Transformer derating (Z)
Harmonic currents or high ambient temperature may cause a temperature rise in the transformer that is above the operating specifications (usually 55° C or 65° C). The transformer must then carry less current to bring the temperature within specified limits. The process that identifies the amount of power available for carrying loads within the specified temperature is called transformer derating. This reads as a percent figure on the PowerProfiler (e.g., 80% means the transformer can only operate at 80% name plate capacity to keep within temperature specifications).

Note that transformers can sometimes operate satisfactorily at higher than specified temperature rises for short periods of time (usually 2 hours in an eight hour period, or 8 hours in a 24 hour period) without affecting insulation life. Continuous operation at higher temperatures will result in shorter economic life. Consult the manufacturer for specifics.

True Power Factor (true PF)
Watts divided by volt-amps. The true power factor will be substantially different from the displacement power factor (cosine ø) when there are large non-linear loads or harmonics present. Displayed in the meter readings and the Power Factor report and snapshot.

Total Harmonic Distortion (THD)
A percentage describing how much a measured waveform differs from an ideal sine wave. Displayed in the meter readings and the Harmonics report and snapshot.

VA
True RMS voltage multiplied by true RMS current. Determines the size and cost of end-use distribution systems (bus ducts, transformers, etc.)

at any level and location. It is a factor in high harmonics and/or low power factor, especially with ASDs (adjustable speed drives), motor controllers, computers, arc welders, process controllers, etc. Displayed in the meter readings and the Power Consumption report.

VAR (volt-amps reactive)
Sine of the displacement or phase angle between fundamental voltage and fundamental current, multiplied by volt-amps. Used to correctly size power factor correction capacitors (and static VAR compensators), and to determine when to turn them on or off. Displayed in the meter readings and the Power Factor report.

Voltage
True RMS voltage; that is, the root of the mean of the squares of the instantaneous voltage; gives correct readings for sine waves, distorted waveforms, offset waveforms, and DC. Displayed in the meter readings and the Voltage and Current report and snapshot.

Watts (Instantaneous power)
The integral of true instantaneous power divided by the sample interval. Displayed in the Power Consumption report and snapshot.

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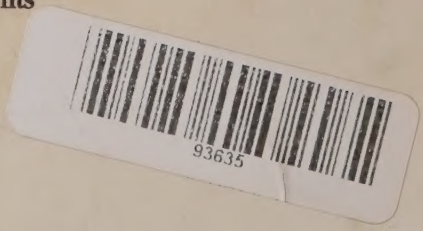

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